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PRACTICAL NAVIGATOR,
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B E I N G

A complete SYSTEM of PRACTICAL NAVIGATION,
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A JOURNAL kept from LONDON to MADEIRA.

WHEREIN IS SHEWN,

How to allow for Lee-way, Variation,
Heave of the Sea, Set of the Currents,
&c. and to correct the dead Reckon-
ing by an Observation, in all Cases.

The Method of Mooring, Unmooring,
and Working a Ship in all difficult
Cases at Sea, on a Lee-Shore, or com-
ing into Harbour.

The Manner of Managing the great

Guns; of Forming the Line; of an
Engagement at Sea; and of Survey-
ing Coasts and Harbours; with an
Explanation of the Sea Terms.

The New Method of finding the Lati-
tude by two Altitudes of the Sun;
and of finding the Longitude by
the Moon's Distance from the Sun
or fixed Star.

To which are added,

The Tables of Difference of Latitude and Departure to 300 Miles Distance;
New Solar Tables; the Table of Natural Sines; a new Table of the
Latitude and Longitude of Places, according to the latest Observations;
a Table, shewing the Times of the rising and setting of the Sun, Moon,
fixed Stars, and Planets; and all other Tables useful at Sea.

CONSTRUCTED UPON A NEW PLAN.

By JOHN HAMILTON MOORE,
Teacher of Navigation, &c. No. 104 in the Minories, Tower-Hill, London.

The EIGHTH EDITION,
Carefully corrected, and greatly enlarged by the AUTHOR.

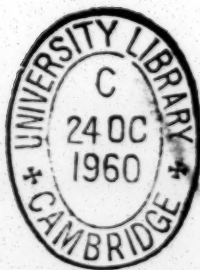
In this Edition are added the Method of finding the LATITUDE by the MOON
and PLANETS; and two COPPER PLATES; one shewing the SOLAR
SYSTEM, the other the TERMS of GEOGRAPHY at one View.

L O N D O N:

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near Tower-Hill.

M,DCC,LXXXIV.

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T O H I S
R O Y A L H I G H N E S S
P R I N C E W I L L I A M H E N R Y.

S I R,

YOUR laudable Ambition of becoming early acquainted with Nautical Knowledge, induced me to place under your Royal Protection, this Edition of Practical Navigation; containing in a small Compass, the Essentials of every useful Discovery and Improvement hitherto made.

The favourable Reception of my former Attempts, not only in the Navy, but also in our Universities and Schools, encouraged me to publish this new and much improved Edition of my Work, under the Patronage of a Prince, who, disdaining the Dangers of the Sea, and softer Amusements of Life, has so nobly embarked in Defence of his Country, and whose beneficent and generous Disposition renders him dear to every Seaman.

That your Royal Highness may long live,
not only to be an Ornament, but a Defence
to this Nation; and that your noble Actions
may be handed down to the latest Posterity,
is a Hope sincerely entertained by

Your Royal Highness'

most obedient

and dutiful Servant,

JOHN HAMILTON MOORE.

P R E F A C E.

I SHALL not amuse the Reader with any pompous Eulogium on the Merits of this Performance, or endeavour, as is customary, to anticipate the public Favour by a Recital of Excellencies, which in the Opinion of some may be of a disputable Nature : This much I may venture to say, the adding one to the Number of Treatises already extant will not appear superfluous, when we consider the Importance of the Subject, and the many recent Discoveries and Improvements made in this valuable Art, which render many of the former Treatises in a Manner obsolete. It must, therefore, be judged absolutely necessary to instruct the industrious Mariner in those interesting Particulars so conducive to his Advantage. On this Principle the following Publication makes its Appearance, containing, in a small Compass, the Essentials of every Thing hitherto composed upon the Subject, laid down in such a Manner as to render it not only a complete Companion for Seamen, but also a short and comprehensive Method for those whose Province it is to instruct others ; for want of such, Teachers often have been obliged to take Part from one Book, and Part from another, not having had any regular Plan to go by.

It must be allowed, that many Books already published upon Navigation have their particular Merits; but some of them are so voluminous, that they either bewilder, or are beyond the Capacity of the greater Number of Learners, and most of them unfit for general Use at Sea. Others, on the contrary, are so concise, especially in the practical Part, as to deprive them of that Knowledge which is absolutely requisite in keeping a Ship's Way. My Care, therefore, has been to avoid an unnecessary Prolixity, and an abstruse Brevity; and to lead the Pupil gradually on, without Embarrassment or Perplexity. How far it will answer the End intended, will, in some Measure, be obvious to any judicious Mariner, by taking a short View of the Plan pursued.

In the Geometrical Parts are given only those Problems which are absolutely necessary in the Art, in the most familiar Manner.

Trigonometry, being the Foundation of Plane and Mercator's Sailing, is treated of at sufficient Length; in which is shewn how to lay down the several Lines upon the Plane Scale, and its Use, with that of Gunter's Scale, and the Logarithms.—The Axioms are here rendered very plain; and though they are generally received as known Truths, yet their Demonstrations are set down at the Bottom of the Page by way of Notes; and all the Cases in Right-angled Trigonometry worked by making each Side Radius and Gunter's Scale.

As an Introduction to Navigation, it was thought proper to give a short Description of the Solar System, wherein the Earth is considered as a Planet moving round the Sun, the real and imaginary Lines on which are particularly defined.

Then follows Plane Sailing, wherein the Earth is supposed an extended Plane, and the several Cases
are

are worked by Geometry, Trigonometry, Gunter's Scale, and Inspection, that the Learner may be able to prove his Work several Ways; and for his Exercise therein, are added six Questions, and two in Traverse Sailing.

Plane Sailing being founded upon the false Notion of the Earths being a Plane, is therefore insufficient for ascertaining the Ship's true Place; hence arises the Necessity of working by Middle Latitude, or Mercator's Sailing, they being founded upon the true Notion of the Earth's being a Sphere or Globe; by which Means the Ship's Place is determined with Ease and Accuracy; in which is comprized the Construction and Use of Mercator's Chart.

The Application of Oblique-angled Trigonometry to the Solution of the several Cases of Oblique and Current Sailing, is treated in as concise and intelligent a Manner as possible.

The Application of what has been already treated of, to the grand Purpose of keeping a Ship's Reckoning, comes next to be explained; preparatory to which it was thought proper to begin with a short Dissertation upon Winds and Tides, and to find the Time of the Moon's Age, and Time of High Water, which is here done by a Method more accurate than is generally to be met with. The Use of Hadley's Quadrant comes next, and how to find the Latitude by the Meridian Altitude of the Sun or Star, and the Variation of the Compass by an Amplitude, Azimuth, and equal Altitudes of the Sun, rendered plain to any common Capacity; and then a Description of the Log and Log-line, and how to correct the Distance given by them when faulty.

The

The Pupil is next led into the Rules for keeping a Journal at Sea ; wherein are exhibited the Method of allowing for Variation, Lee-way, Heave of the Sea, Setting of the Current, &c. and to correct the Dead Reckoning by an Observation in all Cases, not only from the Ship's Run in one Day, but many ; and being duly attended to may be the Means of preventing the fatal Accidents which so frequently befall those Seamen who depend so much upon their own Self-sufficiency. For it must be allowed, that any Observation or Correction made to help the Judgment, must be preferable to a Guess, which but too many of them depend upon, though the Lives and Fortunes of so many are committed to their Charge.

It was thought proper first to shew how to work several Days Work independent of each other, and then a regular Journal from London to Madeira, and back again to England ; wherein are exemplified the foregoing Rules for Variation, Lying-to, Lee-way, &c. with most of the Occurrences that commonly happen at Sea, or in Harbour, and the Ship's Way pricked off on Mercator's Chart.

The Keeping a Sea Journal being fully treated of, as being necessary for rendering the young Navigator expert, which a Number of dry Problems could never do, then is given the Substance of that Examination which every Candidate for a Commission, either in the Navy or East-India Service, must necessarily pass through, previous to his Appointment, respecting the Management of a Ship, from her first coming out of Dock to her clearing the Land, containing the Methods of mooring, unmooring, and working a Ship in all difficult Cases, either in a Storm on a Lee-shore, or going into or out off Harbour

hour. These Instructions being duly attended to, when at Sea, will be the Means of improving a Youth more in one Voyage than he otherwise would in two. To these are added Directions for sailing up the English Channel, shewing the Dangers, and the best Marks to avoid them. The Managing and Exercise of the great Guns, the Manner of forming the Line of Battle, and of an Engagement at Sea.

The next Thing judged necessary is the surveying of Sea Coasts and Harbours, either by sailing along them, or by Observations made on Shore; and how to measure accessible and inaccessible Heights and Distances, which are here laid down in a plain Manner, with an Explanation of the Sea Terms.

The foregoing Articles being well understood, might be thought sufficient to complete the Navigator; but since there have been lately found Methods of ascertaining the Ship's Place by celestial Observation, when the Meridian Altitude of the Sun or Star cannot be obtained; it therefore behoves every Seaman to make himself acquainted with so useful a Discovery.

The first is the finding the Latitude, by taking two Altitudes of the Sun when near the Meridian; in performing which, Care has been here taken to omit nothing that might facilitate the Operations in this useful Problem; and how to find the Latitude by the Planets.

The Latitude being found, there is only wanted the true Longitude for determining the Ship's Place: For notwithstanding the Rules for finding the Longitude, by having the true Latitude, are the most rational that could be given; yet, as they in some Measure depend upon the Ship's Run, they must consequently be liable to Errors; and therefore the Mariner may well be desirous of some other Method that might be depended upon with more Certainty.

The ascertaining the Longitude by celestial Observation so long desired, and now by the Accuracy of Mayer's Lunar Tables, the Excellence of Hadley's Quadrant, and the Industry of Dr. Maskelyne and others, is rendered practical, and without any great Trouble, may be considered as one of the greatest Improvements Navigation has ever received.

The Rules here laid down for performing this important Operation are the most simple that could be given, and are illustrated by a sufficient Number of Examples.

As correct Tables, which this Book abounds with more than any other of the Kind, are of the greatest Importance; besides the Care taken in correcting the Press, they have been further examined and compared with several different Copies of the same Kind, by which Means many Errors in the Tables of Difference of Latitude and Departure have been corrected with such Care, that they may be depended on, and the other Tables are as correct as any extant.

By desire of several Officers belonging to the Royal Navy, I have added to this Edition, a Table of the Semi-diurnal, and Semi-nocturnal Arches, shewing the Time of the Sun, Moon, and Star's setting, when they have North Declination, and the Time of their rising when they have South Declination, and how to find the Latitude by the Planets, their Declination and Time of passing over the Meridian being known by the Nautical Almanac.

In the Execution of this Work Care has been taken to keep in View not only the Mariner at Sea, but also the Teacher in his School; and the best nautical Writers, as well as the Observations and Remarks of several able Mariner's have been consulted. The several Parts of this Work have been handled more or less

less fully according to their apparent practical Importance; and it is hoped nothing is omitted that is material either to the Teacher or actual Practitioner.

Long and tedious Demonstrations have been carefully avoided, as being of little Use in the Practice of Navigation, and inconsistent with the Plan; but those who are curious may find them in Robertson, and some other Books, which abound with them.

Notwithstanding the favourable Reception my Fifth Edition has met with from the Public, and its rapid Sale, yet on Account of its being now read in our Universities and Schools, as well as in the Navy and Merchants Service, I have been induced to revise and correct the Whole, and with great Labour and Expence have added a new Table of the Latitude and Longitude of Places, the most correct now extant, with many other interesting Articles, and made such other Alterations, Amendments and Additions, as render this almost an entire new Work.

Having thus given some Account of the Plan which is intended to facilitate the Improvement of Youth in nautical Knowledge, and be an useful Companion for Seamen; how far I have succeeded in the Attempt is left to the candid Judgment of the Public to determine; thus far I can say, that I have saved Seamen the Expence of buying several Books, formerly imposed on them, as this Book, with the Nautical Almanack are sufficient.

NOTE. All the Calculations for finding the Longitude are made for the Year 1786.

Those who teach by this Book, would do well to provide themselves in Time a Nautical Almanack for the above Year.

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Table 2. A Table of Corrections to be added to the Moon's Semi-diameter, or it is the Augmentation of the Moon's Semi-diameter at each Degree of Altitude.

Table 3. A Table of Corrections to be added to the apparent Altitude of the Moon's Center at each Degree of Altitude, and every ten Seconds of Horizontal Parallax—third Page of this Table is by Mistake placed in Table 4.

Table 4. A Table of the reserved Logarithms, for the readily computing the true Distance of the Moon's Center from the Sun or Star, and are calculated to each Degree of Altitude, and ten Secants of Horizontal Parallax.

Table 5. A Table for turning Degrees and Minutes into Time and the contrary.—These five Tables are inserted for determining the Longitude at Sea without the Assistance of any other Book but the Nautical Ephemeris.

C O N T E N T S

To this Table are added General Rules for knowing the Right Star, to observe and to find the Logarithms of any Number to six Places.

The General Tables stand in the following Order.

- A correct Table of Latitude and Departure for Points to 300 Miles Distance, Ditto for Degrees*
- A large and correct Table of the Latitude and Longitude of Places, with the then Time of High Water, &c.*
- A correct Table of Meridional Parts*
- A Table for finding the Latitude by two Altitudes of the Sun*
- A Table of Natural Sines*
- A Table of Logarithmic Sines, Tangents, and Secants to every Point and Half Point of the Compass*
- A Table of Logarithms from 1 to 1000*
- A Table of Sines, Tangents, and Secants, to every Degree of the Quadrant*
- A Table of the Sun's Right Ascension*
- A Table of the right Ascension and Declination of the principal fixed Stars, with Rules for finding when any of them comes to the Meridian, &c.*
- A Table of the Sun's Declination to the Year 1810*
- A Table of the Variation of the Sun's Declination for every 10 Degrees of Longitude, with Rules for finding the Declination at any Time and Place*
- A Table of Amplitude*
- A Table of Semi-diurnal and Semi-nocturnal Arches, shewing the Time of the Sun, Moon, or Star's Setting when they have North Declination, and the Time of their Rising when they have South Declination, illustrated by Rules and Examples of the Sun, Moon, the fixed Stars and Planets*
- The foregoing Tables are all corrected with such Care, that it is not supposed there is one Error in them, but what is marked in the Errata.*

To this Book are added some useful Hints to Seamen, viz.

*The best Method to prevent Vessels' Anchors from coming Home
Of Fothering a Vessel to stop Leaks*

C O N T E N T S.

Of Vessels driving on Shore

Of Link worming of Cables to prevent them from being wounded or parting in rocky or stoney Ground, and to defend them from Ice. These, and many other Remarks, are inserted in this Book, not to be found in any other of the Kind.

E R R A T A.

Page 31, Question III. For Angle opposite perpendicular $36^{\circ} 15'$ read $33^{\circ} 45' N.$
Java Head in Lat. $6^{\circ} 45' N.$ and Long. $104^{\circ} 50' E.$

- *Just published, Price Three Guineas,*

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T H E

PRACTICAL NAVIGATOR,

A N D

SEAMAN'S NEW DAILY ASSISTANT.

G E O M E T R Y.

D E F I N I T I O N S.

GEOMETRY is that Science by which we compare such Quantities together as have Extension, i. e. Lines, Superficies, and Solids, whose original is from a Point.

I.

A Point hath no Parts; that is, a Geometrical Point is not any Quantity, but only an assignable Place in a Quantity denoted by a Point, as at A. A.

‘ Such a Place may be conceived so infinitely small, as to be void of Length, Breadth, and Thickness; and therefore a Point may be said to have no Parts.’

II.

A Right Line is the nearest Distance between two Points, which limit its Length, as A B.

A————B

III.

Circular Lines are those which lie bending between two Points.

IV.

Parallel Lines are those that are equally distant in all their Parts, which being infinitely extended on the same Plane, will never meet.

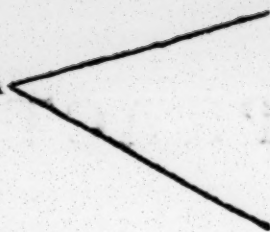
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A

V. Lines

V.

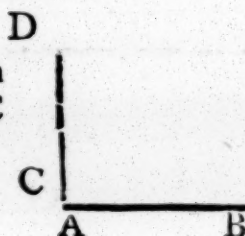
Lines not parallel, but inclining towards each other, whether they are right Lines or circular, will, if they are extended, meet, and make an Angle; the Point where they meet is called the Angular Point, as at A; and according as such Lines stand nearer or farther off each other, the Angle is said to be greater or less, whether the Lines that include the Angle be long or short.



All Angles included between Right Lines, are called Right-lined Angles, and fall under these three Denominations; viz. A Right Angle, an Obtuse Angle, and an Acute Angle.

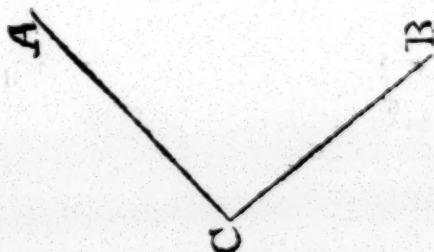
VI.

A Right Angle is that which is included between two Lines that meet each other perpendicular, as DC meets A B.



VII.

An Obtuse Angle is that which is greater than a Right Angle, such as the Angle included between the Lines A C and C B.



VIII.

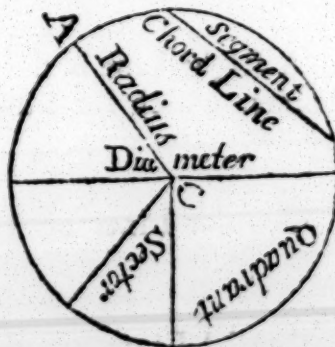
An Acute Angle is that which is less than a Right Angle, such as the Angle included between the Lines C B and C D; these Angles are called Oblique Angles.



IX.

A Circle is a perfect round Figure; the Point C, in the Middle is the Centre, and is bounded by a round Line called its Circumference, or Periphery.

A Right Line, drawn from the Centre to the Circumference, is called the *Radius*, or it is the Distance taken in the Compasses to describe a Circle, as A C.



NOTE

‘ NOTE. The Radius, generally used in describing Circles, is
 ‘ 60° (taken from the Line of Chords) the Circumference of which
 ‘ will contain 360° , the Number of equal Parts or Degrees that all
 ‘ Circles are supposed to be divided into; and each of these Degrees
 ‘ are divided into 60 equal Parts, called Minutes, &c.

‘ All Angles are measured by an Arch of this Circle, described
 ‘ upon the Angular Point as a Centre, with the Chord of 60° , as
 ‘ above, and the Angle is said to be greater or less, according to the
 ‘ Number of Degrees contained between the Legs; but the Sides or
 ‘ Legs are measured by a Scale of equal Parts.’

The *Diameter* is twice its Radius, joined into one Right Line drawn through the Centre which divides the Circle into two equal Parts called Semi-circles.

A *Quadrant* is Half a Semi-circle.

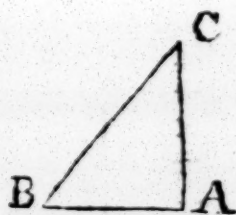
A *Chord Line* is a Right Line that cuts the Circle into two unequal Parts called Segments.

A *Sector* is a Figure included between two Radius's, and is less than a Quadrant-

All Plain Triangles are Figures comprehended under three Right Lines, and are distinguished into three Sorts; viz. A Right-angled Triangle, an Obtuse-angled Triangle, and an Acute-angled Triangle.

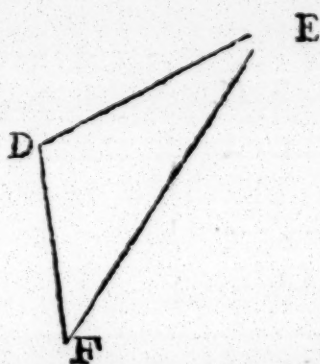
X.

A Right-angled Triangle is that which hath one of its Legs perpendicular to the other, and is equal to a Quadrant or 90° ; as B A C; the longest Side of which is called the Hypotenuse, as B C, and the other two Sides are called Legs.



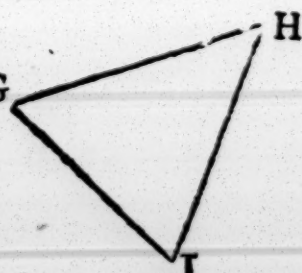
XI.

An Obtuse-angled Triangle is that which hath one of its Angles greater than a Right Angle, as E D F.



XII.

An Acute-angled Triangle is that which hath all its Angles less than a Right Angle, as G H I.



XIII.

The Three Angles of every Triangle are equal to a Semi-circle, or 180° ; the two Acute Angles of every Right-angled Triangle are equal to 90°

XIV.

Sides or Angles given, are marked with a Dash; but, when required, with a Cypher.

XV.

Degrees are always marked with a Cypher over them, ($^\circ$) and Minutes with a Dash. ($'$)

XVI.

Three Letters denote an Angle; the Middle one shews the Angular Point, and the other two the Sides that inclose it.

XVII.

$\begin{matrix} d \\ m \end{matrix}$ { after any Number signifies { Degrees } thus { $\begin{matrix} 25d \\ 25m \end{matrix}$ }
 $25d$ is 25 Degrees, and $25m$ is 25 Minutes.

$\angle$	} stands for {	An Angle
$+$		More
$\times$		Multiplication
$=$		Equal to
$\div$		Division
$-$		Less
$\triangle$		Triangle
S.		Sine
S. C.		Sine Complement or Co-sine
T.		Tangent
T. C.		Tangent Complement or Co-Tangent
Sec.		Secant
Sec. C.		Secant Complement or Co-Secant
Co. Ar.		Complement Arithmetic
...		is to, or to the
...		so is as thus, $2 \dots 4 :: 3 \dots 6$
...		That is, as 2 is to 4, so is 3 to 6

GEOMETRICAL PROBLEMS.

PROBLEM I.

To draw a Line parallel to a given Line A B, at any given Distance, as C.

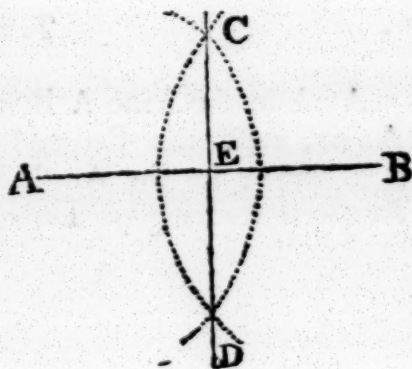
TAKE with a pair of Compasses the nearest Distance between the given Point C and the Line A B.

With that Distance and one Foot of the Compasses, any where in the Line A B, draw (on that Side where the point C lieth) the Arch D, from the Point C draw a Line to touch the Arch D, and it is done; for the Line C D is parallel to the Line A B, as was required.

PROBLEM II.

To bisect or divide a given Line into two equal Parts.

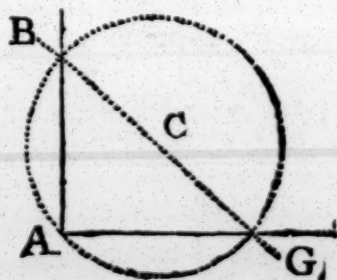
With any Distance (greater than Half the given Line A B) and one Foot of the Compasses on A, describe the Arch C D; with the same Distance and one Foot on B, cross the former Arch in C and D; by C and D draw a Line, and that will cut A B in E the Middle, as was required.



PROBLEM III.

To erect a Perpendicular at the End of a given Line as A G.

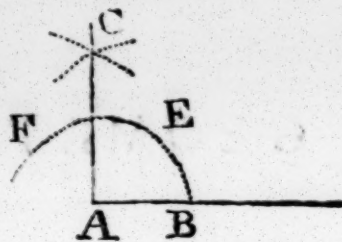
With any Distance, as from A to C in your Compasses, and one Foot in C describe a Circle, so that it may just touch the End of the given Line in A, from where that cuts the Line at G, and through C draw a Line to cut the Circle in B, from B draw the Line A B, which will be the Perpendicular required.



Or,

6 GEOMETRICAL PROBLEMS.

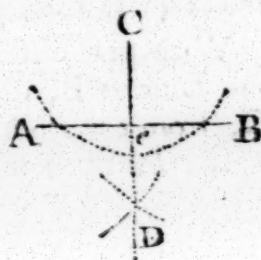
Or, with any convenient Distance in your Compasses describe an Arch, as $F B$, set off the same Distance from B to E , with one Foot in E describe an Arch, and with the same Distance, and one Foot in F , describe an Arch to cut the former Arch in C , from C to A draw a Line, and it is done.



P R O B L E M I V.

From a Point as at C , to let fall a Perpendicular on the Line $A B$.

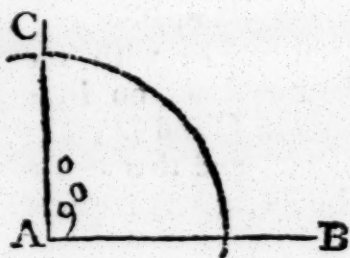
With one Foot in C describe an Arch to cut the given Line in $A B$, with one Foot in B describe an Arch; and with the same Radius, and one Foot in A , describe an Arch to cut the former in D , and from D to C draw a Line, and it is done; for $C e$ is Perpendicular to AB , as was required.



P R O B L E M V.

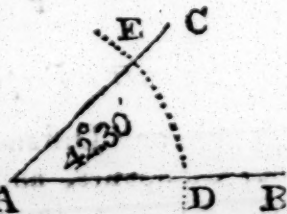
To make Plane-Angles.

At A in the Line $A B$, to make a Right Angle, erect the Perpendicular $A C$, and it is done; for the Angle BAC is a Right Angle containing 90 Degrees.



To make an Angle equal to any given Number of Degrees.

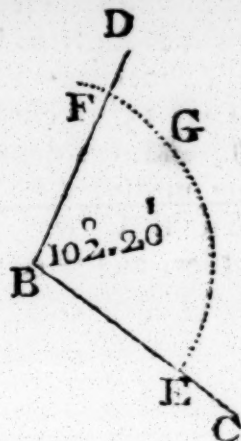
Draw the Line $A B$, and take always a Chord of 60° from the Scale in your Compasses, and with one Foot in A describe the Arch $D E$ to cut the Line $A B$ in D ; take any Number of Degrees, suppose $42^\circ 30'$, from the Line of Chords, and lay it upon the Arch from D to A E ; by A and E draw the Line $A E C$, and it is done; for the Angle $B A C$ is an Acute Angle containing $42^\circ 30'$



GEOMETRICAL PROBLEMS. 7

To make an Obtuse Angle equal to $102^{\circ} 20'$.

Draw the Line B C, and upon B describe an Arch as before, with a Chord of 60° , to cut B C in E, on that Arch set off E G equal to 90° , from G set off $12^{\circ} 20'$ towards F: by B and F draw the Line B F D, and it is done; for the Angle C B D is an Obtuse Angle containing $102^{\circ} 20'$ as was required.



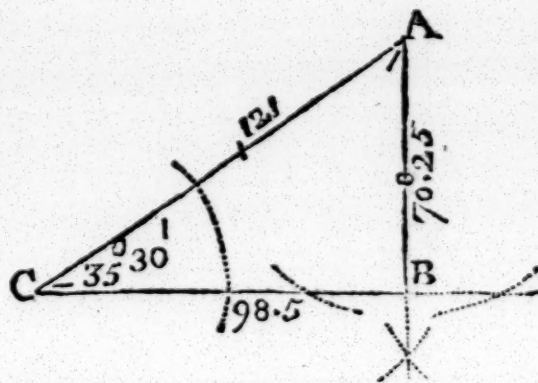
In like Manner an Angle may be made, which shall contain any Number of Degrees required.

PROBLEM VI.

The Angles and Hypotenuse of a Right-Angled Triangle given to find either of the Legs.

Given the Hypotenuse 121 Leagues, the Angle opposite to the Base $54^{\circ} 30'$, and consequently the other Angle $35^{\circ} 30'$; the Base and Perpendicular are required.

Draw the Lines C B and at C make an Angle equal to $35^{\circ} 30'$, by drawing the Line C A, take 121 Leagues in your Compasses (from any convenient Scale of equal Parts) and set that off from C to A. from A let fall the Perpendicular A B, to cut the Line C B, and it is done, for A B being measured on the same Scale, will be 70.25 Leagues, and C B 98.5 as was required.



PROBLEM VII.

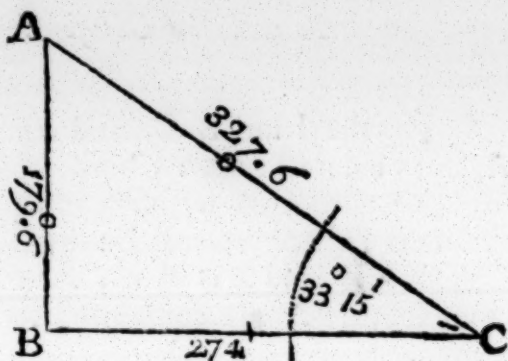
The Angles and one Leg of a Right-Angled Triangle being given, to find the Hypotenuse and other Leg.

The Angle A C B $33^{\circ} 15'$, the Leg B C 274 Miles, given to find the Hypotenuse and the other Leg A B.

Draw

8 GEOMETRICAL PROBLEMS.

Draw the Base BC equal to 274, upon B erect the Perpendicular BA ; from C draw the Line CA , making an Angle with BC of $33^{\circ} 15'$ to cut the Line BA in A , and it is done; for AC being measured on the same Scale that BC was, will be 327.6 Miles, and BA 179.6 Miles, as was required.

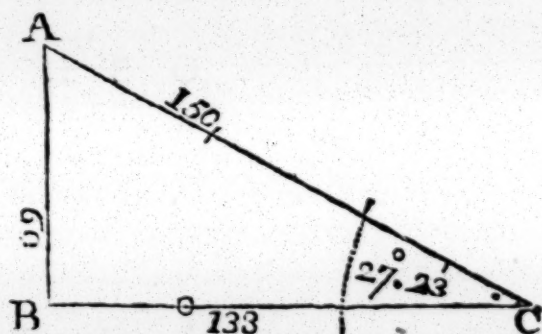


P R O B L E M VIII.

The Hypotenuse and one Leg given, to find the Angles and other Leg.

The Leg AB 69, the Hypotenuse 150, given to find the Angles and Leg BC .

Draw the Base BC , upon B erect the Perpendicular BA , upon which set off 69, take 150 in your Compasses, and with one Foot on A , lay the other on the Base, as at C , from C to A draw a Line, and it is done; for the Angle BCA being measured by a Chord of 60° will be $27^{\circ} 23'$, which being subtracted from 90° leaves the Angle A $62^{\circ} 37'$, and the Leg BC 133, as was required..

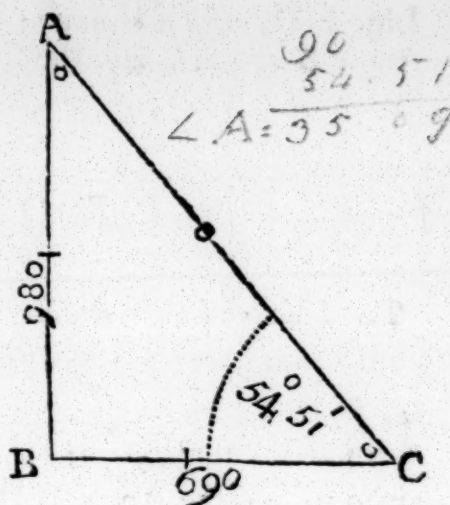


P R O B L E M IX.

The Legs given to find the Angles and Hypotenuse.

The Leg AB 980, BC 690, given to find the Angle BAC or ACB , and the Hypotenuse AC .

Draw the Base BC , on B erect the Perpendicular AB , make BC equal to 690, and BA 980; from A to C draw a Line, and it is done; for the Angle being measured, as before, will be found as in the Figure, and the Hypothenuse 1198, as was required.

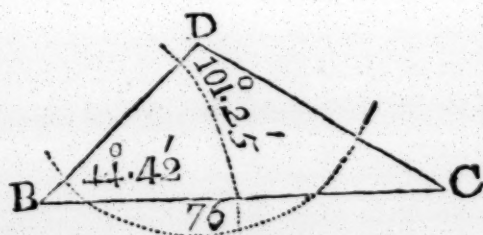


P R O B L E M X.

Two Angles and one Side of an Oblique-angled Triangle, given to find either of the other Legs.

The Angle BDC $101^{\circ} 25'$, and CBD $44^{\circ} 42'$, and the Leg BC 76 given to find the Sides CD and BD .

Draw the Line BC equal to 76, on B describe an Arch, and make the Angle CBD $44^{\circ} 42'$, add the Angles B and D together, that Sum subtracted from 180° (the Sum of the Three Angles of every Triangle) leaves the Angle C $33^{\circ} 53'$; upon C describe an Arch, and make the Angle BCD equal to $33^{\circ} 53'$ by drawing CD , and it is done; for the Side BD will be 43.2. and DC 54.5, which was required.

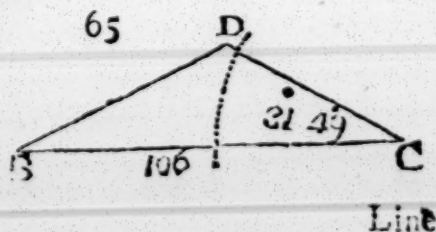


P R O B L E M XI.

Two Sides and an Angle opposite to one of them, given to find the other opposite Angle and the third Side.

The Side BC 106, BD 65 Miles, and the Angle C $31^{\circ} 49'$, given to find the Angle D and Side CD .

Draw the Line BC equal to 106, at C make an Angle of $31^{\circ} 49'$ by drawing CD , take 65 in your Compasses, and with one Foot in B , lay the other upon the Line CD , in D ; draw the



B

Line

10 GEOMETRICAL PROBLEMS.

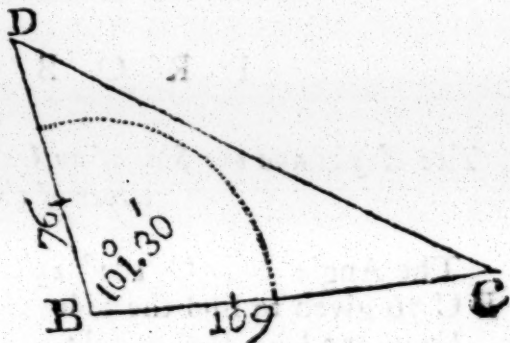
Line B D, and it is done; for the Angle D will be $120^{\circ} 43'$, the Angle B $27^{\circ} 28'$, and the Side D C 56.9, as was required.

P R O B L E M XII.

Two Sides and their contained Angles, given to find either of the other Angles, and the third Side.

The Side B C 109, B D 76 Leagues, and Angle C B D $101^{\circ} 30'$, given to find the Angle B D C, or B C D, and Side C D.

Draw the Line B C 109, and B D, so as to make an Angle with B C of $101^{\circ} 30'$ which make equal to 76; join B C with a Right Line, and it is done; for the Angle D, being measured by the Chord of 60° , will be $47^{\circ} 32'$, Angle C $30^{\circ} 58'$, and the Side D C 144.8, as was required.

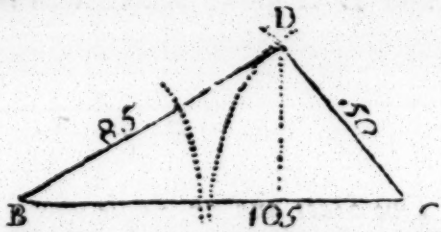


P R O B L E M XIII.

The Three Sides given to find the Angles.

The Sides B C 105, B D 85, and C D 50 Miles, given to find the Angles B D C, B C D, or C B D.

Draw the Line B C equal to 105, take C D 50 in your Compasses, and with one Foot in C describe an Arch as at D, then take B D 85 in your Compasses, and with one Foot in B cut the former Arch in D, join B D and D C, and it is done; for the Angle B, being measured, will be found $28^{\circ} 4'$, Angle C $53^{\circ} 7'$, which being added together, is $81^{\circ} 11'$, thei: Sum subtracted from 180, leaves Angle D $98^{\circ} 49'$ as was required.



P L A N E

PLANE TRIGONOMETRY,
OR THE
DOCTRINE of PLANE TRIANGLES,

TEACHES the Mensuration of Triangles, by comparing the Sides and Angles together by known Analogies ; whereby Three Things being given, a Fourth may be found on Condition that one of them be a Side ; in which, Right Lines are applied to the Arches of a Circle. that the Proportion they bear to the Sides of a Plane Triangle, may be found.

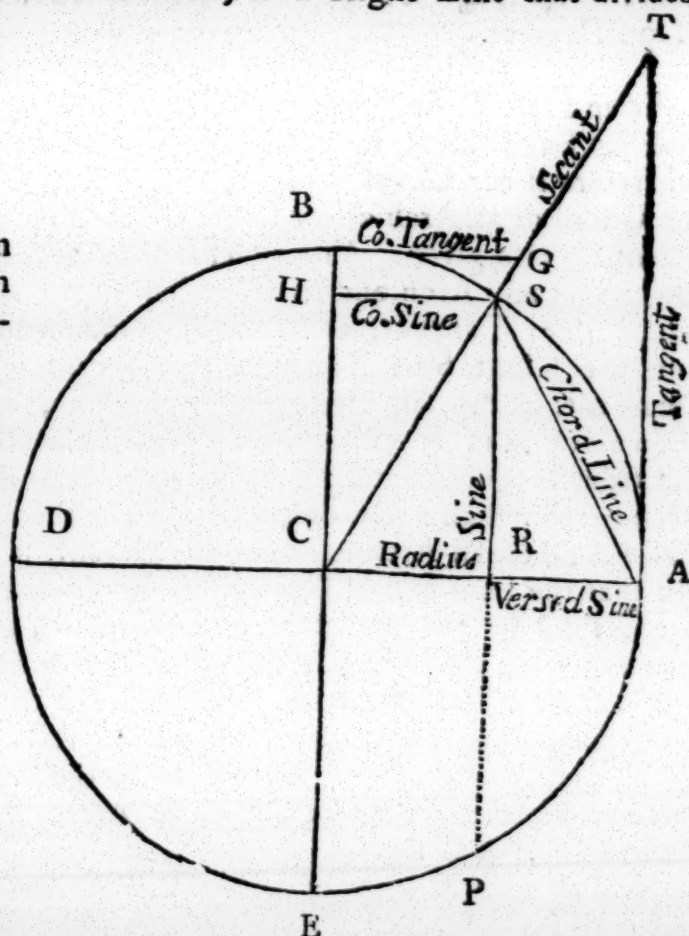
The Right Lines applied to a Circle are Chords, Sines, Tangents, and Secants.

I.

A Chord or Substance of an Arch, is a Right Line that divides a Circle into two unequal Parts, and is a Chord to them both, as A S, and P S.

II.

A Right Sine of an Arch, is a Line drawn from one End or Termination of an Arch perpendicular to the Radius ; or it is Half the Chord of twice the Arch ; so that R S is the Sine of the Arch S A, and of the Arch S D, the Sum of which Arches make 180° , or a Semicircle.



III.

The versed Sine is that Part of the Diameter contained between the Right Sine and the Arch ; wherefore R A is the versed Sine of the Arch S A, and R D, the versed Sine of the Arch S D.

IV.

The Tangent of an Arch, is a Right Line drawn perpendicularly from one End of the Diameter, as A T.

V.

The Secant of an Arch is a Right Line drawn from the Centre through the Circumference, by which the Tangent is terminated; wherefore CT is the Secant of the Arches SA and SD .

VI.

The Sine Tangent, &c. of the Complement of any Arch is called the Co sine, Co-Tangent, &c. of the Arch; Thus, HS is the Co-Sine and BG the Co-Tangent to the Arch AS .

Note. Sines, Tangents, and Secants, are said to be so many Degrees as the Arch contains Parts of 360 Degrees; so that the Radius being the Sine of a Quadrant or a Fourth Part of the Circumference, contains 90 Degrees: Thus the Radius is always equal to the Sine of 90 Degrees.

From these Definitions it follows, that the Chord of any Arch, and its Supplement to a Circle, is represented by the same Line; wherefore if the Chord of an Arch less than a Semicircle be given, the Chord of an Arch as much above a Semicircle as the other is defective, is also given. From Definitions 2d, 4th, and 5th, it follows, that any Arch and its Complement to a Semicircle have one Right Sine, Tangent, and Secant, common to them both. Wherefore the Right Sine Tangent, and Secant of an Arch less than a Quadrant, is the same with the Right Sine, Tangent, and Secant of an Arch as much exceeding a Quadrant as the former is defective, and from Definition the 3d, it follows, that the versed Sine of an Arch greater than a Quadrant, is greater than the Radius; but the versed Sine of an Arch less than a Quadrant, is less than the Radius; and that the Sum and Difference of the Radius and Co-sine of any Arch, shall be the versed Sine of that Arch and its Supplement to a Semicircle; for $DC + CR = DR$ the versed Sine of the Arch DS ; and $AC - CR$, is the versed Sine of the Arch AS .

By comparing the similar Triangles CRS , and CBG , it appears, that the Co-sine of an Arch is to the Right Sine, as the Radius is to the Tangent of the same Arch, and the contrary; for $CR : RS :: AC : CT$.

And, that the Co-sine of an Arch, is to the Radius, as the Radius is to the Secant of the same Arch, and the contrary, for $RC : SC :: AC : CT$.

Hence the Radius is a mean Proportional between the Co-Sine and the Secant of the same Arch; wherefore, the Co-Sines and Secants of Arches are reciprocally proportional.

That

That the Right Sine of an Arch, is to the Radius, as to the Tangent of the same Arch, is to its Secant, and the contrary; for $RS : S. C :: AT : TC$.

And the Tangent of an Arch, is to the Radius, as the Radius is to the Co-Tangent of the same Arch, and the contrary; for $TA : AC :: CB : BG$.

Hence the Radius is a mean Proportional between the Tangent and Co-Tangent of an Arch; wherefore the Tangent of Arches and their Co-Tangents are reciprocally proportional.

That the Tangent of an Arch is to the Secant of the same Arch as the Radius is to the Secant of its Complement, and the contrary; for $AT : TC :: CB : CG$.

The Chords, Sines, Tangents, and Secants, or versed Sines of similar Arches, are in Proportion to each other, as the Radii of those Circles.

By viewing the Figure, it will appear, that if the longest Side of the Triangle CRS be made the Radius of a Circle, the other Sides will be Sines of the Angles opposite to them; but if one of the Sides containing the Right Angle be made Radius, the other will be the Tangent of the Angle opposite to it, and the Hypothenuse, or longest Side, the Secant of the same Angle.

Having explained the Properties of a Right-angled Triangle at some Length, it being the Foundation of Plane and Mercator's Sailing; we shall now proceed to shew how to determine the several Lengths of the Sines, Tangents, and Secants belonging to the several Arches, answering to every Degree and Minute of the Quadrant, in Parts of the Radius first given, and how to lay them down on the Plane Scale.

THE

T H E
FUNDAMENTAL PROJECTION
OF THE LINES OF

Sines, Tangents and Secants, on the Plane Scale.

1st. **W**ITH the Radius you intend for your Scale describe a Semicircle $A D B C$, and upon the Centre C raise the Perpendicular $C D$, (which will divide the Semicircle into two Quadrants, $A D$, $B D$) continue $C D$ directly to S , and upon B raise the Perpendicular $B T$, then draw the Right Lines $B D$ and $A D$.

2^{dly}. Divide the Quadrant $B D$ into 9 equal Parts, then will each of these be 10 Degrees. Again, you may subdivide each of these Parts into single Degrees: And these again, if your Radius will admit of it, into Minutes, or some Aliquot Parts of a Degree greater than Minutes.

3^{dly}. Set one Foot of the Compasses in B , and transfer each of the Divisions in the Quadrant $B D$ to the Right Line $B D$; then is $B D$ a Line of Chords.

4^{thly}. From the Points 10, 20, 30, &c. in the Quadrant $B D$, draw Right Lines parallel to $C D$ till they cut the Radius $C B$; then is the Line $C B$ divided into a Line of Sines, which must be numbered from C towards B .

5^{thly}. If the same Line of Right Sines be numbered from B towards C , it will become a Line of versed Sines; which may be continued to 280° , if the same Divisions be transferred on the other Side the Centre C .

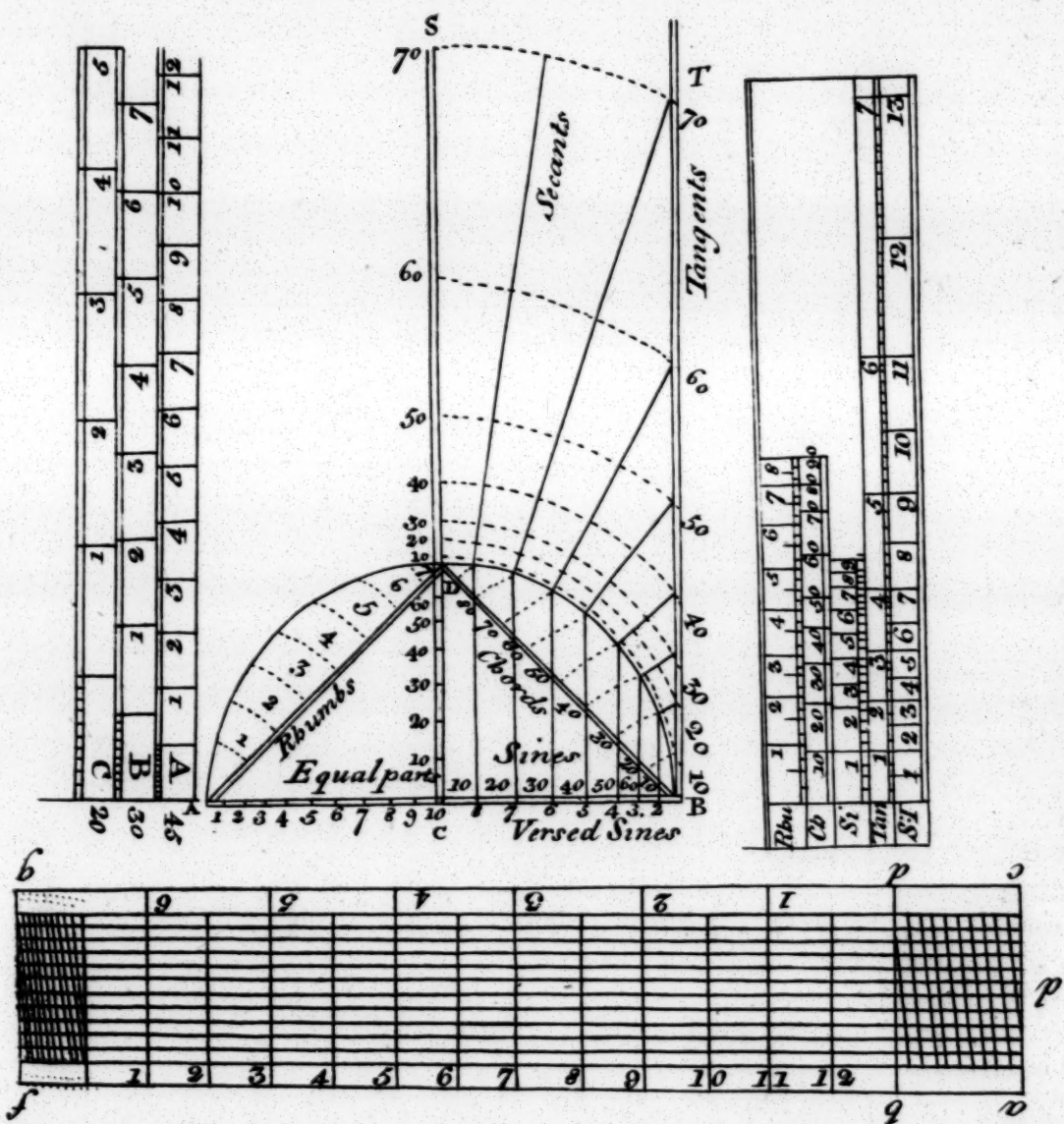
6^{thly}. From the Centre C through the several Divisions in the Quadrant $B D$, draw Right Lines till they cut the Tangent $B T$; so will the Line $B T$ become a Line of Tangents.

7^{thly}. Setting one Foot of the Compasses in C , extend the other to the several Divisions, 10, 20, 30, &c, in the Tangent Line $B T$, and transfer these Extents severally into the Right Line $C S$, then will the Line $C S$ be a Line of Secants.

8^{thly}. Right Lines drawn from A to the several Divisions, 10, 20, 30, &c. in the Quadrant $B D$, will divide the Radius $C D$ into a Line of Semitangents.

9^{thly}. Divide the Quadrant $A D$ into 8 equal Parts, and from A transfer these Divisions severally into the Line $A D$; then is $A D$ a Line of Rhumbs, each Division answering to $11^\circ 15'$ upon the Line of Chords. The Use of this Line is for protracting and measuring

Facing Page 14



furing of Angles according to the common Divisions of the Mariner's Compass. If the Radius A C be divided into 100 or 1000, &c. equal Parts, and the Lengths of the several Sines, Tangents, and Secants, corresponding to the several Arches of the Quadrant, be measured thereby, and these Numbers be set down in a Table, each in its proper Column, you will by this Means have a Triangular Canon of Numbers, by which the several Cases in Trigonometry may be resolved. The Right Lines graduated as above, being placed severally upon a Ruler, form the Instrument called the Plane Scale; by which the Sines and Angles of all Triangles may be measured. All Right Lines (as the Sides of Plane Triangles, &c. when they are considered simply as such, without having any Relation to a Circle) are measured by Scales of equal Parts; one of which is subdivided equally into 10, and this serves as a common Division to all the Rest. In most Scales an inch is taken for a common Measure, to determine their Largeness and Number of Parts: what an Inch is divided into, is generally set at the End of the Scale, as in the Scales A, B, and C; the Numbers 10, 20, 30, shew that so many Parts of the Scales A, B, C, are contained in an Inch. By any Scale of equal Parts divided as above, any Number less than 100 may be readily taken; but if the Number should consist of Three Places of Figures, the Value of the Third Figure can only be guessed at: wherefore in these Cases, it is better to use such a Scale as D, called a Diagonal Scale, by which any Number of Three Figures may be exactly found.

Having prepared a Ruler of convenient Breadth for your Scale, (which may be an Inch more or less) First, near the Edges thereof, draw Two Right Lines *af*, *cg*, parallel to each other; then divide one of these Lines as *af*, into equal Parts, according to the Largeness you intend your Scale; and through each of these Divisions draw perpendicular Right Lines as far as the Line *cg*; next divide the Breadth into 10 equal Parts; and through each of these Divisions draw Right Lines parallel to the former *a f* and *c g*; again, divide the Length, *a, b, c, d*, each into 10 equal Parts; and from the Point *d* to the first Division in the Line *A B*, draw a Right Line; then, parallel to that Line, draw Right Lines through all the other Divisions, and the Scale is done.

Besides the Lines already mentioned, there is another on the Plane Scale marked *ML*, which is joined to a Line of Chords; and shews how many Miles Easting or Westing make a Degree of Longitude in every Latitude; these several Lines are generally put on one Side of a Ruler 2 Feet long; and on the other Side are laid down a Scale of the Logarithms of the Sines, Tangents, and Numbers, which is commonly called Gunter's Scale; and as it is of general Use, it requires a particular Description.

T H E
D E S C R I P T I O N and U S E

G F

G U N T E R ' s S C A L E .

GUNTER's Scale, hath set upon it these Eight Lines following.

1st. Sine Rhumbs (marked S R) is a Line which contains the Logarithm of the Sine of every Degree, Point, and Quarter Point of the Mariner's Compass, figured from the Left Hand towards the Right, with 1, 2, 3, 4, 5, 6, 7, to 8, where is a Brass Pin, and where it can, it is divided into Halves and Quarters.

2d. Tangent Rhumbs (marked T R) also corresponds to the Logarithm of the Tangent of every Degree of the said Compass, and is figured 1, 2, 3, 4, at the Centre, where is a Pin, and from thence towards the left Hand with 5, 6, 7, it is also divided, where it can, into Halves and Quarters.

3d. The Line of Numbers (marked Num.) contains the Logarithm of the Numbers, and is figured thus; near the Left Hand End it begins at 1, and towards the Right Hand is 2, 3, 4, 5, 6, 7, 8, 9; then 1 is the Middle, at which is a Brass Centre Pin, going still on 2, 3, 4, 5, 6, 7, 8, 9, and 10 at the End, where is another Centre Pin: (As this Line is generally used, it requires a larger Description) The first 1 may be counted for 1, or 10, or 100, or 1000, and then the next 2 is accordingly 2, or 20, or 200, or 2000, &c. Again, the first 1 may be reckoned for 1 Tenth, or 1 Hundredth, or 1 Thousandth Part, &c. then the next is 2 Tenth, 2 Hundredth, or 2 Thousandth Parts, &c. so that if the first 1 be esteemed 1, the Middle 1 is then 10, and 2 to its Right is 20, 3 is 30, 4 is 40, and 10 at the End is 100; again, if the First 1 is 10, the next 2 is 20, 3 is 30, and so on, making the Middle 1 now 100, the next 2 is 200, 3 is 300, 4 is 400, and 10 at the End is now 1000. In like Manner if the First 1 be esteemed for 1 Tenth Part, the next is 2 Tenth Parts, and the Middle 1 is 1, and the next 2 is 2, and 10 at the End is now 10. Again, if the First 1 be counted 1 Hundredth Part, the next is 2 Hundredth Parts, the Middle 1 is now 10 Hundredth Parts or 1 Tenth Part, and the next 2 is 2 Tenth Parts, and 10 at the End is now but one whole Number or Integer.

As the Figures are increased or diminished in their Value, so in like Manner must all the intermediate Strokes or Subdivisions be increased or decreased; that is, if the First 1 (at the Left Hand) be counted 1, then 2 (on the Right Hand of it) is 2; and each Subdivision between them now is 1 Tenth Part, and so all the Way to the Middle 1, which now is 10, the next 2 is 20; now the
longer

longer Strokes between 1 and 2 are to be counted from 1 thus: 11, 12, (where is a Brass Pin) then 13, 14, 15, (sometimes a longer Stroke than the rest) then 16, 17, 18, 19, and 20 at the Figure 2; and all the shorter Strokes between these longer are now each to be counted for a Tenth Part, from the Middle 1 to the next 2, now 20, from whence the longer Strokes between the Figures are Units, thus 21, 22, 23, &c. to 3, which now is 30, and the shorter Strokes between them, each now is a Tenth Part of an Integer; from 3 each short Stroke, or little Division, is 5 Tenth Parts of an Unit.

Again, if one at the left Hand be 10, the Figure between it and the Middle 1 are common Tens; and the Subdivisions, between each Figure, are Units; and from the Middle 1 to 10 at the End, each Figure is so many Hundreds; and between these Figures each longer Division is 10, and from the Middle 1 to 2, each less Division is 2 Units; from 2 to the End, each shorter Stroke is 5 Units.

From this Description it will be easy to find the Divisions representing a given Number, thus: Suppose the Point representing the Number 12 was required; take the Division at the Figure 1 in the Middle for the First Figure of 12, then for the Second Figure count 2 Tenths, or longer Strokes, to the Right Hand, and this Last is the Point representing 12.

Again, suppose the Number 22 was required, the First Figure being 2, I take the Division to the Figure 2 for it, and for the Second Figure 2 count 2 Tenths onwards, and that is the Point representing 22.

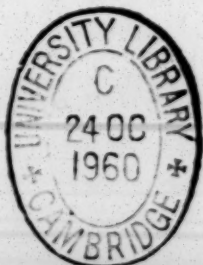
Again, suppose 1728 was required; for the First Figure 1 I take the Middle 1, for the Second Figure 7 count onward as before, and that is 1700; then for the 2, the Third Figure count 2 Tenths from the last, and it represents 1720; lastly for the Fourth Figure 8, estimate 8 Tenths of the next small Division, or a little less than 10, this Point last found represents 1728.

Required the Point representing the Number 435? From the 4 in the Second Interval, count towards 5 in the Right, Three of the larger Divisions and one of the smaller, and that will be the Division expressing 435; and the like of other Numbers, which by a little Practice is readily done.

All Fractions found in this Line must be Decimals; and if they are not, they must be reduced into Decimals, which is easily done by extending the Compasses from the Numerator to the Denominator, that Extent laid upon 1 in the Middle will reach to the Decimal required.

Example, required the Decimal Fraction equal to $\frac{4}{3}$? Extend from 4 to 3, that Extent will reach from 1 in the Middle to .75 towards the Left Hand; the like may be observed of any other Vulgar Fraction.

C



Multiplication

Multiplication is performed on this Line by extending from 1 to the Multiplier, that Extent will reach from the Multiplicand to the Product.

Suppose, for Example, it was required to find the Product of 16 multiplied by 4: Extend from one to 4, that Extent will reach from 16 to 64; the Product required.

Division being the Reverse of Multiplication, therefore extend from the Divisor to 1, that Extent will reach from the Dividend to the Quotient.

Suppose 64 is to be divided by 4, extend from 4 to 1, that Extent will reach from 64 to 16, the Quotient. The same with any other Numbers.

Proportion, or the Rule of Three, being performed by Multiplication and Division, therefore extend from the First Term to the Second, that Extent will reach from the Third to the Fourth.

Example, If the Diameter of a Circle be 7 Inches, and the Circumference 22, what is the Circumference of another Circle the Diameter of which is 14 Inches?

Extend from 7 to 22, that Extent will reach from 14 to 44, the Circumference required.

In like Manner may any other Proportion be worked of any Denomination, which makes this Line of general Use, particularly in measuring of Superfices and Solids, which is done by extending from 1 to the Breadth, that Extent will reach from the Length to the Superficial Content.

Example, suppose a Plank or Board 15 Inches broad, and 27 Feet long, the Content of which is required.

Extend from 1 to 1 Foot 3 Inches, that Extent will reach from 27 Feet to 33,75 Feet the Superficial Content; or extend from 12 Inches to 15 Inches, that Extent will reach from 27 Feet to 33,75 Feet.

The Solid Content of any Bale, Box, Chest, &c. is found by extending from 1 to the Breadth, that Extent will reach from the Depth to a Fourth Number, and the Extent from 1 to that Fourth Number will reach from the Length to the Solid Content.

Example 1st. What's the Content of a Square Pillar, whose Length is 21 Feet 9 Inches, and Breadth 1 Foot 3 Inches?

The Extent from 1 to 1,25 will reach from 1,25 to 1,56, the Content of 1 Foot in Length; again, the Extent from 1 to 1,56 will reach from the Length 21,75 to 33,8, the Solid Content in Feet.

Example 2d. Suppose a Square Piece of Timber 1,25 Feet broad, ,56 deep, and 36 Feet long, be given, to find the Content: Extend from 1 to 1,25, that Extent will reach from ,56, to ,7; then extend from 1 to ,7, that Extent will reach from 36 to 25,2, the Solid Content. In like Manner may the Contents of any Bales, &c. be found, which divided by 40 will give the Tonage.

3d. *The Line of Sines* (marked SINES) begins at the Left Hand, and Figured thus : 1, 2, 3, &c. to 10; then 20, 30, 40, &c. to 90, ending at the Right Hand, where is a Brass Centre Pin : These Figures never change their Value or Denomination, being here (and in all Lines under it) called Degrees.

4th. *The Line of versed Sines* (marked V. S.) begins at the Right Hand against 90, in the Sines, and from thence Figured towards the Left Hand, thus : 10, 20, 30, 40, &c. ending at the Left Hand End about 169 Degrees; the Subdivisions are from 10 to 30, each are 2 Degrees; from thence to 90, (it is single Degrees) and from thence to the End; it is divided each into 15 Minutes.

5th. *The Line of Tangents* (marked TAN.) begins at the Left Hand as the Sines do; from thence Figured to the Right Hand, thus : 1, 2, 3, &c. to 10, and so on 20, 30, 40, and 45 at the Right Hand, where is a little Brass Centre Pin, just under and even with 90 in the Sines, from thence back again it is Figured 50, 60, 70, 80, &c. to 89, ending at the Left Hand where it began at 1 Degree. The Subdivisions of this Line are the same as those of the Sines.

6th. *The Line of Meridional Parts* (marked MER.) begins at the Right Hand, and numbered thus : 10, 20, 30, to the Left Hand, where it ends at 87 Degrees. This Line, with the Line of Equal Parts (marked E. P.) under it are used together, only in Mercator's Sailing. The uppermost Line contains the Degrees of the Meridian or Latitude, in a Mercator's Chart; and the lower is the Equator, and contains the Degrees of Longitude.

THE USE OF THE LOGARITHMS.

LOGARITHMS are a series of Numbers, invented by Lord Napier, a Scotch Nobleman, by which the Work of Multiplication may be performed by Addition; and the Operation of Division may be done by Subtraction; for if the Logarithm of the Multiplier be added to the Logarithm of the Multiplier, that Sum will be the Logarithm of the Product; and if from the Logarithm of the Dividend you subtract the Logarithm of the Divisor, the Remainder will be the Logarithm of the Quotient. Again, if the Logarithm of any Number be divided by 2, the Quotient will be the Logarithm of the Square Root of that Number; or if the Logarithm of any Number be divided by 3, the Quotient will be the Logarithm of the Cube Root of that Number.

In the first Page of the Tables you will find the Logarithm of the Numbers from 1 to 120, which are continued to 10,000. To find the Logarithm of any Number proceed thus: 1st. If the Number be less than 100, suppose 45, look for 45 in the Column marked N° . opposite to which is 1.65321, the Logarithm required. Again, suppose the Logarithm 741 is wanted, look for 741 in the Column marked N° . opposite to that is 2.86982, the Logarithm; but if the Number consists of more than 3 Places, suppose 5738, find the first 3 Figures 573 in the Column marked N° . and right over and under 8 stands 2.75876; but as the Number is above 3 Places of Figures, the Figure or Index must be called 3, and then it will stand thus, 3.75876, the Logarithm required. On the contrary, when a Logarithm is given to find the Number belonging to it, look among the Logarithms for the nearest to it, opposite which in the Column of N° . will be found the Number required. Suppose, for Example, the Logarithm 2.75662 was given, I find the nearest to it in the Table is 2.75664; opposite to that is 571, the Number required. Again, suppose the Logarithm 3.74763 was given to find its Number, looking in the Table I find nearest thereto under 3, and opposite to 559, now because the Index is 3, I call it 5593, which is the Number required; for when the Number is under 10 the Index is always 0; from 10 to 100 the Index is 1; from 100 to 1000 the Index is 2; from 1000 to 10,000 the Index is 3; from 10,000 to 100,000 the Index is 4, &c.

To find the Logarithm of an Absolute Number and a Decimal.

If the Decimal consists of one Place and the whole Number be under 100, look for the Whole Number and Decimal as if it was an absolute Number in the Column of Numbers, opposite to that will be the Logarithm required, observing to separate the last Figure in the

the

the Number for a Decimal, and to call the Index 1 if above 10 and under 1000; but if under 10 the Index is 0. Required the Logarithm of 57.5? opposite to 575 is 2,75967, calling the Index 1 it will be 1.75967, the Logarithm of 57.5.

Having the Logarithm, the Number is found by the Inverse of the above, as for Example:

Required the Number answering to the Logarithm 2,98798? Looking in the Table I find that Logarithm under (7) and opposite 972, therefore 972.7 is the Number sought.

When there are two Places of Decimals, find the Whole Number, and the first Place of the Decimal in the Column of N°. as before, and the last Figure in the Column marked 1 | 2 | 3 | &c. above, and at the Angle of Meeting will be the Logarithm required. Example, Required the Logarithm of 44.49? look for 444, and Right over and under 9 is 2.64826, making the Index 1 it will be 1.64826, the Logarithm of 44.49, having the Logarithm, the Number is found as before.

Example, Required the Number answering to this Logarithm 0.75450? looking in the Table I find that Logarithm under 2, and opposite 568 in the Column of Numbers; now as the Index is (0) the 5 only is a whole Number, and 68 set before the 2 above will make the Decimal 682, consequently the Number is 5,682.

To find the Logarithm of the Sine, Tangent, or Secant, belonging to any Number of Degrees and Minutes required.

If the required Degrees be less than 45 seek the Degrees on the Top, and the Minutes in the Left Hand Column marked M, against which in the Column signed at the Top with the proposed Name, stands the Sine, Tangent, and Secant required; but when the Degrees given are more than 45 seek the Degrees at the Bottom, and the Minutes in the Right Hand Column marked M at the Bottom, and the proposed Name at the Bottom. Here it may be observed, that the Degrees at the Top and Minutes at the Left Hand Column added to the Degrees at the Bottom, and Minutes in the Right Hand Column always make 90°; hence, if a Sine be looked for, the Complement to it will be found in the adjoining Column; the same of Tangents and Secants

Example 1st. Required the Logarithm of the Sine 28° 37'?

Find 28° at the Top of the Page, and in the Left Hand Column marked M at the Top find 37, against which in the Column marked with the word Sine, stands 9.68029, the Logarithm of the Sine of 28° 37' required; the same may be observed of Tangents and Secants.

Example 2d. Required the Logarithm of the Tangent of 67° 45'?

Find 67° at the Bottom of the Page, and 45 in the Right Hand Column marked M at the Bottom, against this in the Column marked Tangent at the Bottom stands 10.38816, which is the Logarithm required.

Having

Having the Sine, Tangent, or Secant, the Co-Sine, Co-Tangent, and Co-Secant are always found in the adjoining Columns.

The Logarithm of any Number of Degrees above 90° is found by subtracting the given Degrees from 180° , and taking the Logarithms of the Remainder.

To find the Complement Arithmetic of any Logarithm given.

The Complement Arithmetic of a Logarithm is what it wants of 10.00000, or 20.00000, and is used to avoid Subtraction; for finding it this is the Rule; take the Residue or Remainder of the first Figure to 9, and so of the Rest until you come to the last Figure, of which take its Remainder under 10, and it is done.

Example 1st. I would have the Complement Arithmetic of 9.62595?

For the first Figure 9 write 0; for 6, 3; for 2, 7; for 5, 4; for 9, 0; and for the last Figure 5 write 5; and so you have 0.37405, for the Complement Arithmetic sought.

Example 2d. The Complement Arithmetic of 20.33133?

For 0, (always rejecting the first Figure, when there are two Figures in the Characteristic) write 9, and so on as before directed, and then you will have 9.66867, which is the Complement Arithmetic of 20.33133.

Or thus :

From	10.00000	From	20.00000
Take	9.62595	Take	10.33133
Comp. Arith. required	<u>0.37405</u>	Comp. Arith. required	<u>9.66867</u>

The Logarithm for Degrees, Minutes, and Seconds is found by taking the Difference between the next greater and lesser Logarithm; and saying, as $60''$: is to that Difference :: so is the Seconds given : to a fourth Number, which fourth Number being added to the Right Hand of the next less Logarithm gives the Logarithm required. By the Reverse of this, when the Logarithm is given, the Seconds may be found.

But if the given Seconds be $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, or nearly any other even Parts of a Minute, the like Parts may be taken of the Difference of the Logarithms, and added to the next less Logarithm, and that will be the Logarithm of the Degrees, Minutes, and Parts of a Minute required.

The same may be observed of Natural Sines.

The

The following Things relating to Plane Trigonometry should be well understood.

Notwithstanding what has been said in Geometry, it may not be here improper to observe,

A Plane Triangle is any three Corner'd Figure bounded by three Right Lines, and consists of six Parts, three Sides and three Angles.

The Angles of every Plane Triangle are measured by an Arch of a Circle, described on their Angular Point with the Chord of 60 Degrees, and are said to be greater or less according to the Number of Degrees contained between their Legs, but the Sides or Legs are always measured by a Scale of equal Parts.

A Degree is the 360th Part of the Circumference of any Circle.

All Circles, whether great or small, are divided into 360 equal Parts, called Degrees, and each Degree into 60 equal Parts called Minutes, and each Minute into 60 equal Parts called Seconds, &c.

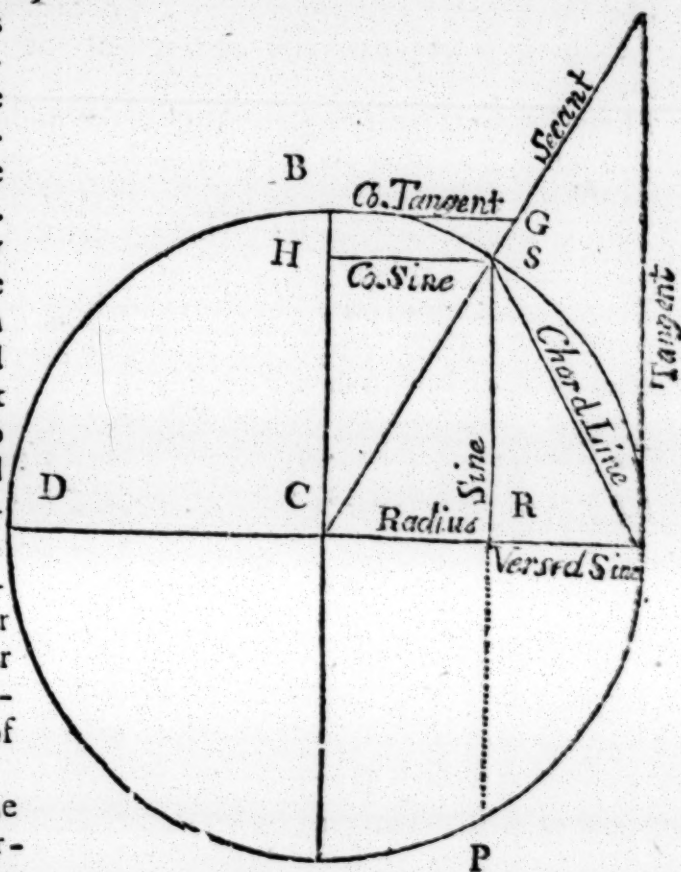
A Semicircle is 180 Degrees, and a Quadrant contains 90 Degrees.

A Right Angle contains 90 Degrees. an Obtuse Angle more than 90; and an Acute Angle less than 90 Degrees.

The Three Angles of every Plane Triangle contain 180 Degrees.

In a Right Angled Triangle the Right Angle contains 90 Degrees, and the two Acute Angles 90 Degrees between them, therefore if one of the Acute Angles in a Right Angled Triangle be given, the other Angle is found by subtracting the given Angle from 90 Degrees.

When one of the Angles in any Plane Triangle is given, the Sum of the other two Angles is found by subtracting the given Angle from 180 Degrees; and if two Angles are given, the Third is found by subtracting the Sum of the given Angles from 180 Degrees.



The Complement of an Angle is what it wants of 90 Degrees.

The Supplement of an Angle is what it wants of 180 Degrees.

The Chord of 60° , Sine of 90° , and Tangent of 45° are equal, and also equal to the Radius.

The Co-Sine, Co-Tangent, and Co-Secant of an Arch are the Right Sines, Tangents, and Secants of the Complement of that Arch.

Three Letters signifying an Angle, the middle one shews the Angular Point, the other two the Legs that include it.

Degrees are marked with a Cypher over them, and Minutes with a Dash, also Sides or Angles given are marked with a Dash, but if required with a Cypher.

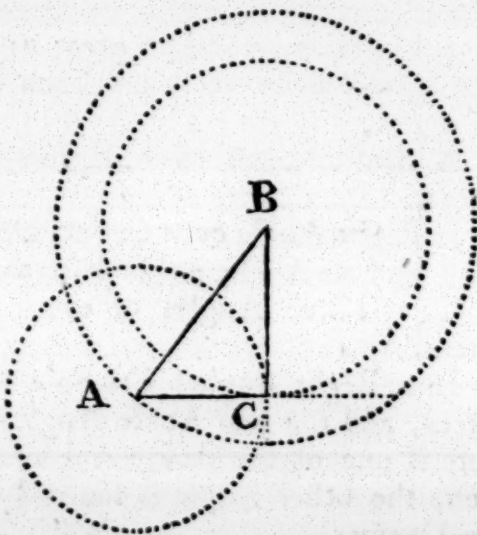
The Logarithm of any Angle exceeding 90 Degrees is found by subtracting the given Angle from 180 Degrees, and taking the Logarithm of the Remainder.

The Solution of the several Cases in Plane Trigonometry depend on four Propositions called AXIOMS, which should be got perfectly by Heart.

A X I O M I.

In any Right-Angled Plane Triangle, if the Hypotenuse, or longest Side, be made the Radius of a Circle, the other two Sides, or Legs, will be the Sines of their opposite Angles : But if either of the Legs, including the Right Angle, be made Radius, the other Leg becomes the Tangent of its opposite Angle, and the Hypotenuse the Secant of the same Angle.*

For in the Triangle ABC , let AB be made the Radius of a Circle, and with one Foot of the Compasses on A or B describe a Circle, it is plain that the Leg BC will be the Sine of the Angle A , and AC the Sine of the Angle B : But if AC be made Radius, BC becomes the Tangent of the Angle A , and BA the Secant of the same Angle.



Again,

* NOTE. As this Axiom shews how to work any Proportion in Plane Traverse, or Mercator's Sailing ; therefore, the Terms of Plane Sailing may be applied to the Right angled Triangle, and then proceed to Plane Sailing

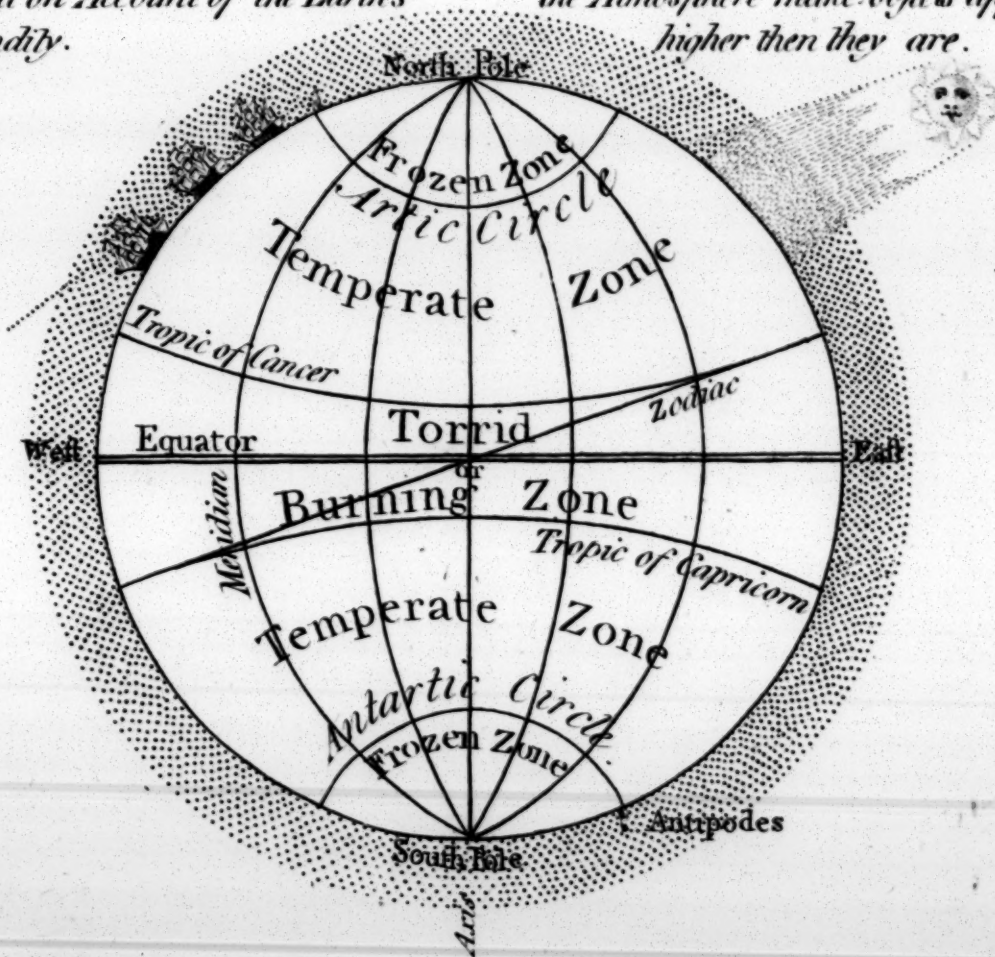
Geographical TERMS explain'd at one VIEW.



Geographical CIRCLES and ZONES.

We lose sight of distant Objects at Sea on Account of the Earth's Roundness.

The Rays of light Passing through the Atmosphere make objects appear higher than they are.



Again, by making BC Radius, AC will be Tangent, and AB the Secant of the Angle B : Hence it is plain, that the different Sides take their Names according to which Side is made Radius.

In a Right-angled Triangle, there are always two Sides, or the Angles and one Side given to find the rest.

To find a Side, any Side may be made Radius, then say,

As the Name of the given Side : is to the given Side : : so is the Name of the Side required : to the Side required.

To find an Angle, one of the given Sides must be made Radius, then say as the Side made Radius, is to Radius, so is the other given Side to the Sine Tangent, or Secant, by it represented, which fourth Proportion must be looked for in the Table of Sine Tangent, &c. where will be found the Degrees and Minutes corresponding to the Angle required.

The same may be observed in stating all Cases in Trigonometry, as in the Rule of Three in Arithmetic, where we are taught to multiply the second and third Terms together, and divide their Product by the first Term, and the Quotient will be the fourth Term, or Number sought; and of the same Denomination the second Term was of. And since Addition of Logarithms answers the Purpose of Multiplication in Arithmetic, Subtraction and Division, we have this general Rule for working all Proportions by Logarithms, viz. Add the Logarithms of the second and third Terms together, and from that Sum subtract the Logarithm of the first Term, the Remainder will be the Logarithm of the fourth Term, and of the same Name the second Term was of.

Consequently, to find a Side we must begin the Proportion with a known Angle, opposite to a known Side, and to find an Angle we must begin with a known Side when the second Term will be Radius, which is always taken as a known Angle.

C A S E I.

The Angles and Hypothenuse given, to find either of the Legs.

Given, the Hypothenuse 121 Leagues; the Angle opposite to the Base $54^{\circ} 30'$; and consequently, the other Angle $35^{\circ} 30'$; the Base and Perpendicular are required.

Sailing immediately, without going through Trigonometry, if the Pupil's Time be short; and may be rendered thus:

In any Case in Plane Sailing, if the Distance be made Radius, the Departure will be the Sine, and the Difference of Latitude the Sine Complement of the Course.

But if the Departure is made Radius, the Difference of Latitude will be the Tangent, and the Distance the Secant of the Complement of the Course,

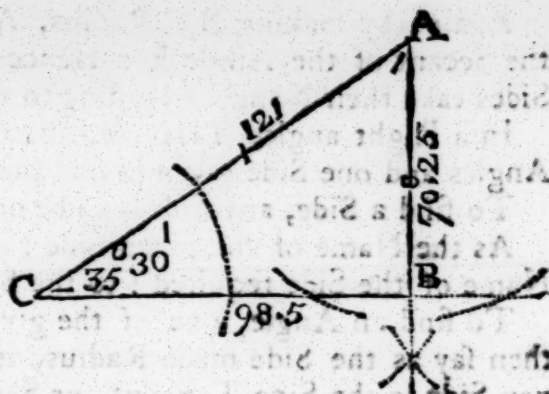
And if the Difference of Latitude is made Radius, the Departure will become the Tangent, and the Distance the Secant of the Course.

D

For

For the Construction see
Problem VI. in Geometry.

From $90^{\circ} 00'$
Take Angle A $= 54^{\circ} 30'$
Leaves Angle C $= 35^{\circ} 30'$



NOTE. These being the same Figures brought forward, which were constructed in Geometry, therefore, if the Learner is any Time at a Loss how to construct any of them, he may turn back to the Problem referred to.

By making the Hypothenuse C. A. Radius, the Proportion by Axiom the First will be

To find the Base B C.		To find the Perpendicular A B.	
As Radius 90°	10.00000	As Radius 90°	10.00000
Is to Hypoth. C A 121	2.08278	Is to the Hypoth. C A 121	2.08278
So is Sine Ang. A $54^{\circ} 30'$	9.91069	So is Sine Ang. C $35^{\circ} 30'$	9.76395
	<u>11.99347</u>		<u>11.84673</u>
	10.00000		10.00000

To the Base B C 98.51 1.99347 To the Perpen. A B 70.26 1.84673
By making the Base B C Radius, the Proportion by Axiom the First will be,

To find the Base B C.		To find the Perpendicular A B.	
As Sec. Ang. C $35^{\circ} 30'$	10.08931	As Sec. Ang. C. $35^{\circ} 30'$	10.08931
Is to the Hypoth. A C 121	2.08278	Is to the Hypoth A C 121	2.08278
So is Radius 90°	10.00000	So is Tang. Ang. C $35^{\circ} 30'$	9.85327
	<u>12.08278</u>		<u>11.93605</u>
	10.08931		10.08931

To the Base B C 98.51 1.99347 To the Perpen. AB 70.26 1.84674

By making the Perpendicular A B Radius the Proportion by Axiom the First will be.

To find the Base B C		To find the Perpendicular A B.	
As Sec. Ang. A. $54^{\circ} 30'$	10.23605	As Sec. Ang. A $54^{\circ} 30'$	10.23605
Is to the Hypoth. A C 121	2.08278	Is to Hypoth. A C 121	2.08278
So is Tang. Ang. A $54^{\circ} 30'$	10.14673	So is Radius 90°	10.00000
	<u>12.22951</u>		<u>12.08278</u>
	10.23605		10.23605

To the Base B C 98.51 1.99346 To the Perpend. A B 70° 26' 1.84673

By

By GUNTER'S SCALE.

In all Proportions wrought by Gunter's Scale, when the first and second Terms are of the same Kind, then the Extent from the first Term to the second will reach from the third to the fourth.

Or when the first and third Terms are of the same Kind:

The Extent from the first Term to the third will reach from the second to the fourth; that is, set one Point of the Compasses on the Division, expressing the first Term, and extend the other Point to the Division, expressing the second (or third) Term; then, without altering the Opening of the Compasses, set one Point on the Division representing the third Term (or second Term) and the other Point will fall on the Division, shewing the fourth Term or Answer.

Now in the last Case it will be thus:

Extend from Radius or 90° to $54^\circ 30'$ on the Line of Sines; that Extent will reach from the Hypotenuse 121 to the Base 98.5 on the Line of Numbers.

2dly. Extend from Radius to $35^\circ 30'$ on the Line of Sines; that Extent will reach from the Hypotenuse 121 to the Perpendicular A B $70^\circ 26'$ on the Line of Numbers.

Observe the like in all that follows, except in those Proportions where the Word *Secant* is mentioned; which may be readily wrought, by considering the Hypotenuse Radius, as in the last Case, there being no Line of Secants on Gunter's Scale.

NOTE. The Radius, according to the Nature of the Proportion, may be any of these, viz.

8 Points on the Line of Sine Rhumbs || 90° on the Line of Sines.

4 Points on the Line of Tan Rhumbs || 45° on the Line of Tang.

C A S E S II. and III.

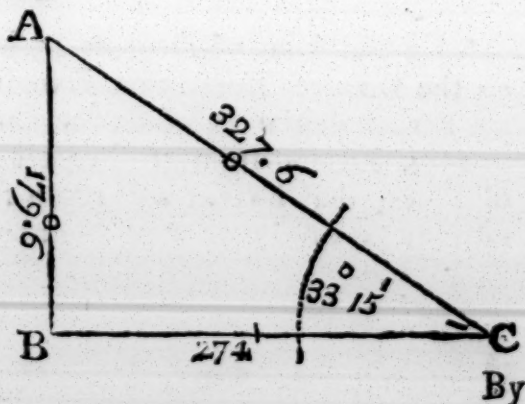
The Angles and one Leg given to find the Hypotenuse and other Leg.

The Angle A C B $33^\circ 15'$, the Leg B C 274 Miles, given, to find the Hypotenuse and other Leg.

For the Construction see Problem VII. in Geometry.

		$^\circ$	$'$
Angle C	—	90	00
		33	15
Angle A	—	56	45

D 2



TRIGONOMETRY.

By making the Hypothenufe A C Radius, it will be,

To find the Perpendicular A B.			To find the Hypothenufe A C		
As Sine Ang. A.	$56^{\circ} 45'$	9.92235	As Sine Ang. A	$56^{\circ} 45'$	9.92235
Is to the Base B C	274	2.43775	Is to the Base B C	274	2.43775
So is Sine Ang. C	$33^{\circ} 15'$	9.73901	So is Radius	90°	10.00000
		<u>12.17676</u>			<u>12.43775</u>
		9.92235			9.92235
To the Perpen. A B 179.6 2.25441			To the Hypoth. A C 327.6 2.51540		

By making the Base B C Radius it will be,

To find the Perpendicular A B.			To find the Hypothenufe A C.		
As Radius 90°		10.00000	As Radius 90°		10.00000
Is to the Base B C	274	2.43775	Is to the Base B C	274	2.43775
So is Tang. Ang. C.	$33^{\circ} 15'$	9.81666	So is Sec. Ang. C	$33^{\circ} 15'$	10.07765
		<u>12.25441</u>			<u>12.51540</u>
		10.00000			10.00000
To the Perpen. A B 179.6 2.25441			To the Hypoth. A C 327.6 2.51540		

By making the Perpendicular A B Radius it will be,

To find the Perpendicular A B.			To find the Hypothenufe A C.		
As Tang. Ang. A.	$56^{\circ} 45'$	10.18334	As Tang. Ang. A	$56^{\circ} 45'$	10.18334
Is to the Base B C	274	2.43775	Is to the Base B C	274	2.43775
So is Radius	90°	10.00000	So is Sec. Ang. A.	$56^{\circ} 45'$	10.26099
		<u>12.43775</u>			<u>12.69874</u>
		10.18334			10.18334
To the Perpen. AB. 179.6 2.25441			To the Hypoth. A C 327.6 2.51540		

By GUNTER.

* Extend from 56 Degrees 45 Minutes to 33 Degrees 15 Minutes on the Line of Sines, that Extent will reach from the Base 274 to the Perpendicular 179.6 on the Line of Numbers.*

2dly. Extend from 56 Degrees 45 Minutes to Radius on the Line of Sines, that Extent will reach from the Base 274 to the Hypothenufe 327.6 on the Line of Numbers.*

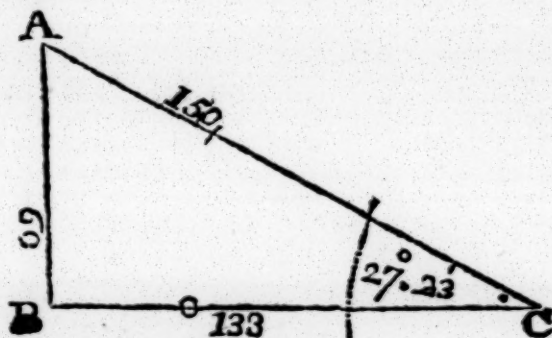
CASES

CASES IV. and V.

The Hypothenufe and one Leg given to find the Angles and other Leg.

The Leg AB 69, the Hypothenufe 150 given to find the Angle ACB, or BAC, and Leg BC.

For the Construction see Problem VIII. in Geometry.



By making the Hypothenufe Radius, it will be,

To find Angle C.		To find the Base BC.	
As the Hypothenufe 150	2.17609	As Radius	10.00000
Is to Radius	10.00000	Is to the Hypoth. 150	2.17609
So is Perpendicular 69	1.838885	So is S. Ang. A 62° 37'	9.94839
	11.83885		12.12448
	2.17609		10.00000
To Sine Angle C 27° 23'	9.66276	To the Base 133.2	2.12448

By making the Perpendicular Radius, it will be,

To find Angle A.		To find the Base BC.	
As the Perpendicular 69	1.83885	As Radius	10.00000
Is to Radius	10.00000	Is to the Perpend. 69	1.83885
So is the Hypoth. 150	2.17609	So is Tang. Ang. 62° 37'	10.28568
	12.17609		12.12453
	1.83885		10.00000
To Sec. Ang. A 62° 37'	10.33724	To the Base 133.2	2.12453

By G U N T E R.

‘Extend from Hypothenufe 150, to the Perpendicular 69, on the Line of Numbers, that Extent will reach from Radius to Sine Angle C 27 Degrees 23 Minutes on the Line of Sines.’

2dly. ‘Extend from Radius 10 Sine Angle A 62 Degrees, 37 Minutes, that Extent will reach from the Hypothenufe 150 to the Base 133.2 on the Line of Numbers.’

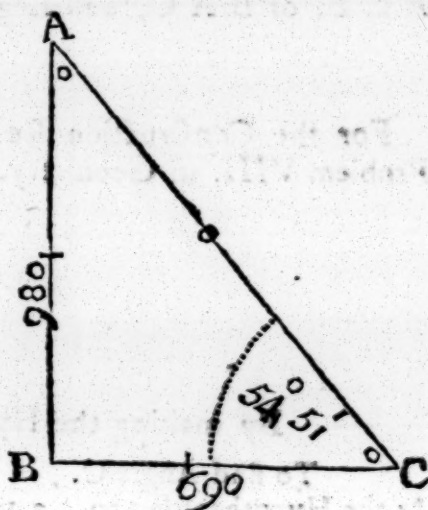
CASE

CASES VI. and VII.

The Legs given to find the Angles and Hypothenufe.

The Legs A B 980, B C 690 given to find the Angle B A C, or A C B, and the Hypothenufe A C.

For the Construction see Problem IX. in Geometry.



By making the Base Radius, it will be,

To find Angle C.		To find the Hypoth. A C.	
As the Base 690	2.83885	As Radius	10.00000
Is to Radius	10.00000	Is to the Base 690	2.83885
So is the Perpend. 980	2.99123	So is Sec. Ang. C 54° 51'	10.23979
	12.99123		13.07864
	2.83885		10.00000
To Tang. Ang. C 54° 51'	10.15238	To the Hypoth. 1198	3.07864

By making the Perpendicular Radius, it will be,

To find Ang. A.		To find the Hypoth. A C.	
As the Perpend. 980	2.99123	As Radius	10.00000
Is to Radius	10.00000	Is to the Perpend. 980	2.99123
So is the Base 690	2.83885	So is Sec. Ang. A. 35° 9'	10.08743
	12.83885		13.07866
	2.99123		10.00000
To Tan. Ang. A. 35° 9'	9.84762	To the Hypoth. 1198	3.07866

By G U N T E R.

' The Extent from 690 to 980 on the Line of Numbers, will reach from Radius (or 45 Degrees) to 54.51 on the Line of Tangents.'

2dly. ' The

2dly. 'The Extent from Sine Angle A 35 Degrees 9 Minutes to Radius, or 90 Degrees, will reach from the Base 690 to the Hypothenufe 1198; on the Line of Numbers.'

NOTE. When the Degrees and Minutes of one Angle of a Right Angled Triangle is found, the other Angle is also given in the Tables, without subtracting from 90° , whether in Sines, Tangent, or Secants, for one Angle is always the Complement of the other; therefore if the Degrees at the Top of the Tables, and the Minutes in the Left Hand Column, which always correspond with the Logarithmic Sine Tangent or Secant increasing downwards is found; then the Degrees less than 90° belonging to the other Angle will be at the Bottom of the Tables, and the Minutes in the Right Hand Column; and, on the contrary, if the Degrees at the Bottom and the Minutes in the Right Hand Column correspond with the Logarithmic Sine, Tang. &c. then the Degrees of the other are at the Top, and the Minutes in the left Hand Column.

Questions to Exercise the Learner in Trigonometry.

Quest. 1. The Hypothenufe 98 Miles and the Angle opposite to the Base $33^\circ 45'$ given to find the Base and Perpendicular.

Ans. Base 54.45 and Perpend. 81.48 Miles.

Quest. 2. The Perpend. 82 Leagues and Angle opposite to the Base $33^\circ 45'$ given to find the Hypoth. and Base.

Ans. Hypoth. 98.62 and Base 54.79 Leagues.

Quest. 3. The Base 82 Yards and the Angle opposite to the Perpend. $56^\circ 15'$ given to find the Hypoth. and Perpendicular.

Ans. Hypoth. 98.62 and Base 54.79 Yards.

Quest. 4. The Hypoth. 126 and Perpend. 70 Miles given to find the Base.

Ans. Base 104.8 Miles.

Quest. 5. The Hypoth. 124 and the Base 86 Miles given to find the Perpend.

Ans. Perpend. 89.35 Miles.

Quest. 6. The Base 64 and Perpend. 114 Leagues given to find the Hypoth.

Ans. Hypothenufe 130.8 Leagues.

O B L I Q U E

OBLIQUE TRIGONOMETRY.

A X I O M II.

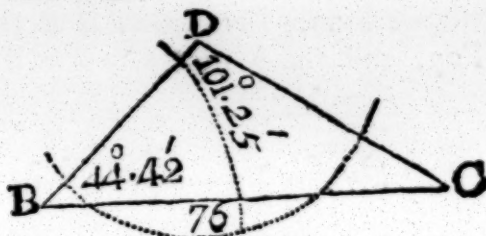
IN all Plane Triangles, the Sides are in direct Proportion to the Sines of their opposite Angles.*

C A S E I.

Two Angles and one Side given to find either of the other Legs.

The Angle B D C $101^{\circ} 25'$ and C B D $44^{\circ} 42'$, and the Leg B C 76 given to find the Sides C D and B D.

For the Construction see Problem X. in Geometry.

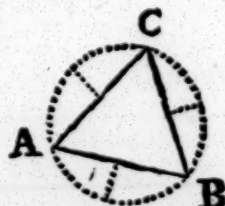


The Proportion by Axiom II. will be

To find D C.

As Sine Angle D $101^{\circ} 25'$	—	—	9.99132
Is to the Side B C 76	—	—	1.88081
So is Sine Angle B $44^{\circ} 42'$	—	—	9.84720
			11.72801
			9.99132
To the Side D C 54.53	—	—	1.73669

* Let the Triangle A B C be circumscribed with a Circle, its plain that each Side becomes a Chord to its respective Arch; from hence, as the Chord of the Arch A C is to the Chord of the Arch C B, so is the Side A C to the Side C B.



Now it has been shewn, that half the Chord is the Sine of the Arch subtended by that Chord; therefore in the Triangle A B C, the Sines of the Angles will be as the Halves of their opposite Sides; and since the Halves are as Wholes, it follows, that the Sines of the Angles are as their opposite Sides; that is, A C : C B :: Sine Ang. B : to Sine Ang. A, &c.

To

To find B D.

As Sine Ang. D $101^{\circ} 25'$ 9.99132
 Is to the Side B C 76 1.88081
 So is Sine Ang. C $33^{\circ} 53'$ 9.74625

11.62706

9.99132

To the Side B D 43.23

1.63574

The Sum of the Angles D & B 146.7

From 180.0
 Subtract 146.7

The Remainder is the Ang. C 33.53

180.0

101.25

The Supplem. of the Ang. D 78.35

By G U N T E R.

'Extend from the Supplement of Angle D $78^{\circ} 35'$ to Angle B $44^{\circ} 42'$ on the Line of Sines, that Extent will reach from the Side B C 76, to the Side D C 54.53 on the Line of Numbers.'

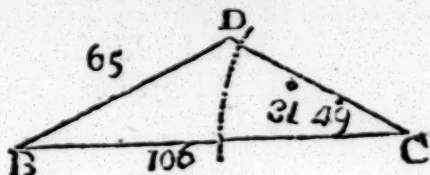
2dly. 'Extend from the Supplement of Angle D $78^{\circ} 35'$ to Angle C $33^{\circ} 53'$ on the Line of Sines, that Extent will reach from the Side B C 76, to the Side B D 43.23 on the Line of Numbers.'

C A S E S I. and II.

Two Sides and an Angle opposite to one of them given, to find the other opposite Angle and third Side.

The Side B C 106, D B 65 Miles, and the Angle B C D $31^{\circ} 49'$ given to find the Angle B D C obtuse, and the Side C D.

For the Construction see Problem XI. in Geometry.



The Proportion by Axiom II. will be

To find Angle D.

As the Side B D 65 ——— 1.81291
 Is to Sine Angle C $31^{\circ} 49'$ ——— 9.72198
 So is the Side B C 106 ——— 2.02531

11.74729

1.81291

To Sine Angle D $120^{\circ} 43'$

9.93438

E

As

To find D C.		180. 0	
		The Supplem. 59.17 of Angle D.	
As Sine Ang. C - $31^{\circ} 49'$	9.72198	120.43	Angle D
Is to the Side B D 65	1.81291	31.49	Angle C
So is Sine Ang. B 27.28	9.66392		
		152.32	their Sum
		180. 0	
		152.32	Sum. subt.
		27.28	Angle B
To the Side D C - 56.88			

Here it may be proper to observe, that if the given Angle be Obtuse, the Angle sought will be Acute; but when the given Angle is Acute, and opposite to a Lesser given Side, then the required Angle is doubtful, whether Acute or Obtuse; it ought, therefore, to be determined before the Operation. For it is plain the above Proportion produces $59^{\circ} 17'$ for the required Angle; but as it is Obtuse, its Supplement to 180 Degrees must be taken, viz. $120^{\circ} 43'$.

By G U N T E R.

'The Extent from 65 to 106 on the Line of Numbers, will reach from $31^{\circ} 49'$ to $59^{\circ} 17'$ on the Line of Sines.'

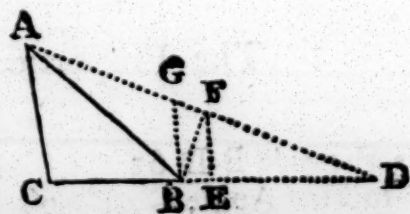
2dly. 'The Extent from $31^{\circ} 49'$ to $27^{\circ} 28'$ on the Line of Sines, will reach from 65 to 56.88 on the Line of Numbers.'

A X I O M III.

In every Plane Triangle it will be, as the Sum of any two Sides, is to their Difference, so is the Tangent of half the Sum of the Angles opposite these Sides to the Tangent of Half their Difference.

'Which half Difference, being added to half the Sum of the Angles, gives the greater; but if subtracted, the Remainder will be the lesser Angle.*'

* Produce the lesser Leg C B of the Triangle A B C, till B D becomes equal to B A; then bisect D C in E; join A D and bisect it also in F, which (by 2. 6. Eucl.) will be perpendicular to A D, and draw E F, which (by 2. 6. Euclid.) will be parallel to A C. Then will the Angles A B F = F B D = $\frac{1}{2}$ A B D, which external Angle A B D is (32. 1. Eucl.) = A B C + B C A, that is the Sum of the opposite Angles required.



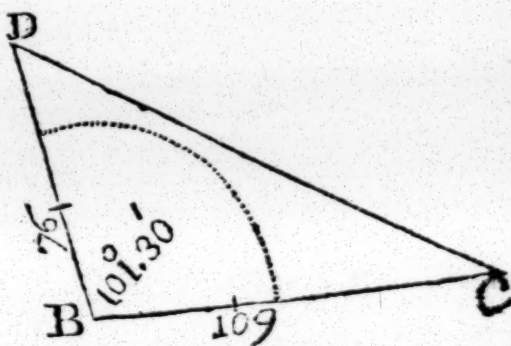
Then draw B G parallel to C A, so will the Angle G B A be (by 29. 1. Eucl.) equal to its alternate one B A C. And if from half the Sum of the opposite

C A S E S IV. and V.

Two Sides and their contained Angles given, to find either of the other Angles, and the third Side.

The Side BC 109, BD 76 Leagues, and Angle CBD $101^{\circ} 30'$ given to find the Angle BDC, or BCD, and Side CD.

For the Construction see Problem XII. in Geometry.



Side BC	109	—	109	—	180° 0'
BD	76	—	76	—	101 30
their Sum	185				
		33	their Diff.	78 30	Sum of two Angles D and C
				$\frac{1}{2}$ 39 15	

opposite Angles, you take the lesser Angle; that is, if from Angle ABF you take the Angle GBA, there will remain the Angle GBF = half the Difference of the opposite Angles: And so also if from CE, $\frac{1}{2}$ the Sum of the Legs, you take CB the lesser Leg, there will remain BE = $\frac{1}{2}$ the Difference of the Legs. And since the Angle ABF is Right-angled, if BF be made Radius, AF will be the Tangent of the Angle ABF, (that is, the Tangent of $\frac{1}{2}$ the Difference of the opposite Angles;) and in the little Triangle GBF, GF will be the Tangent of the Angle GBF, (that is, the Tangent of half the Difference of the opposite Angles:) but the Segments of the Legs of any Triangle cut by Lines parallel to the Base, being (by Eucl. 2. 6.) proportional EC : CB :: FA : FG, that is, half the Sum of the Legs is to half their Difference, as the Tangent of half the Sum of the opposite Angles is to the Tangent of half their Difference: but Wholes are as their Halves; wherefore the Sum of the Legs is to their Difference, as the Tangent of half the Sum of the Angles opposite, is to the Tangent of half their Difference.

The Proportion by Axiom III. will be

To find the Angles D C.

As the Sum of the Sides B C and B D = 185 ——— 2.26717
Is to their Difference ——— 33 ——— 1.51851
So is Tang. of $\frac{1}{2}$ the Sum of the Angles C and D $39^{\circ} 15'$ 9.91224

11.43075

2.26717

To the Tan. of $\frac{1}{2}$ the Diff. of the Angles C and D $8^{\circ} 17'$ 9.16358

To half the Sum of the Angles D and C ——— $39^{\circ} 15'$
Add half the Difference of the Angles C and D ——— 8 17

Gives the greater Angle D ——— 47 32
Subtracted, gives the lesser Angle C ——— 30 58

Having the Angles, the Side is found by AXIOM II. for it will be,

To find D C.

As Sine Angle D $47^{\circ} 32'$ ——— ——— 9.86786
Is to the Side B C 109 ——— ——— 2.03743
So is Sine Angle B $101^{\circ} 30'$ ——— ——— 9.99119

12.02862

9.86786

To the Side D C required 144.8 ——— 2.16076

By G U N T E R.

'The Extent from 185 to 33 on the Line of Numbers, will reach from $39^{\circ} 15'$ to $8^{\circ} 17'$ on the Line of Sines.'

2dly. 'The Extent from Angle D $47^{\circ} 32'$ to $78^{\circ} 30'$ (the Supplement of Angle B) on the Line of Sines, will reach from the Side B C 109 to 144.8, the Side D C required on the Line of Numbers.'

A X I O M IV.

In any Plane Triangle, as the Base or greatest Side is to the Sum of the other two Sides, so is the Difference of the Sides to the Difference of the Segments of the Base; made by a Perpendicular let fall from the Angle opposite to the Base.

'And if half the Difference of the Segments be added to half their Sum, it will give the greater Segment; but if subtracted, the Remainder will be the lesser Segment.'

'The

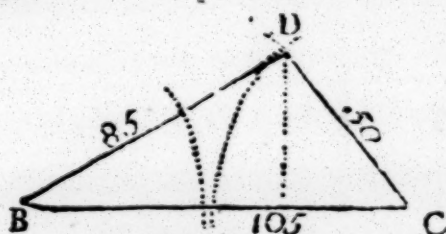
“The Triangle being thus cut, becomes two Right-angled Triangles, the Hypothenuses and Bases of which are given, to find the Angles by Axiom I.*”

C A S E VI.

Three Sides given, to find the Angles.

The Sides BC 105, BD 85, and CD 50 Miles, given to find the Angles BDC , BCD , or CBD .

For the Construction see Problem XIII. in Geometry.



BD 85 A
 CD 50

The Sum of the two shortest Sides

135

The Difference of the two shortest Sides

35

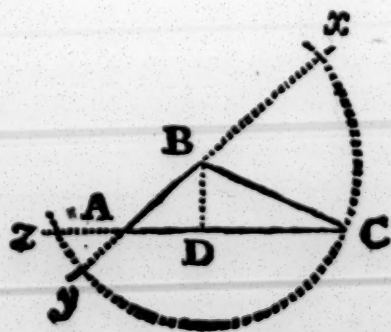
The Proportion by Axiom IV. will be,
To find BC .

As the Side BC	105	2.02119	$52\frac{1}{2}$	the half of gr. Side
Is to the Sum of the Sides BD & DC	135	2.13033	$22\frac{1}{2}$	half Dif. of the Seg
So is the Dif. of the Sides BD & DC	35	1.54407	—	
		—	75	the greatest S. gm.
		3.67440	—	
		2.02119	30	lesser Segment.

Dif. of the Seg. of the Base or gr. Side 45, 1.65321

* From the Angle B in the Triangle ABC let fall the perpendicular BD ; on B , as a Centre with the greater Leg BC , as a Radius describe the Circle $BXCZY$ and produce AB to X and Y , and CA to Z . Then (by 35. 3. Euclid.) $AY \times AX = AC \times AZ$; viz. : $BC - BA : x : BC + BA : AC - DA$;

Therefore $A : C + BA :: BC - BA ; DC - DA$; otherwise let the Difference of the Squares of the Sides BC and AB be taken, and divided by the Base AC , the Quotient shall be the Difference of the Segments of the Base aforesaid.



Having

Having divided the Right-angled Triangle into two Right-angled Triangles, the Hypotenuses and Bases of which are given, to find the Angles by Axiom I. as follows :

To find Angle B D A.

As the Hypotenuse B D 85	1.92942		90° 0'
Is to Radius	10 00000		61 56
So is the greatest Segment 75	1.87506		
	11.87506	leaves Angle B	28 4
	1.92942		
			90 0
			36 53
To Sine Angle B D A—61° 56'	9.94564		
		leaves Angle C	53 7

To find Angle A D C.

As the Hypotenuse D C 50	1.69897	Co. Ang. B D A	28 4
Is to Radius	10.00000	Com. Ang. A D C	53 7
So is the lesser Segment A C 30	1.47712		
	11.47712	Sum	81 11
	1.69897		
		Sum	180 0
			81 11
To the Sine Angle A D C 36° 53'	9.77815		
		Ang. B D C	98 49

By G U N T E R.

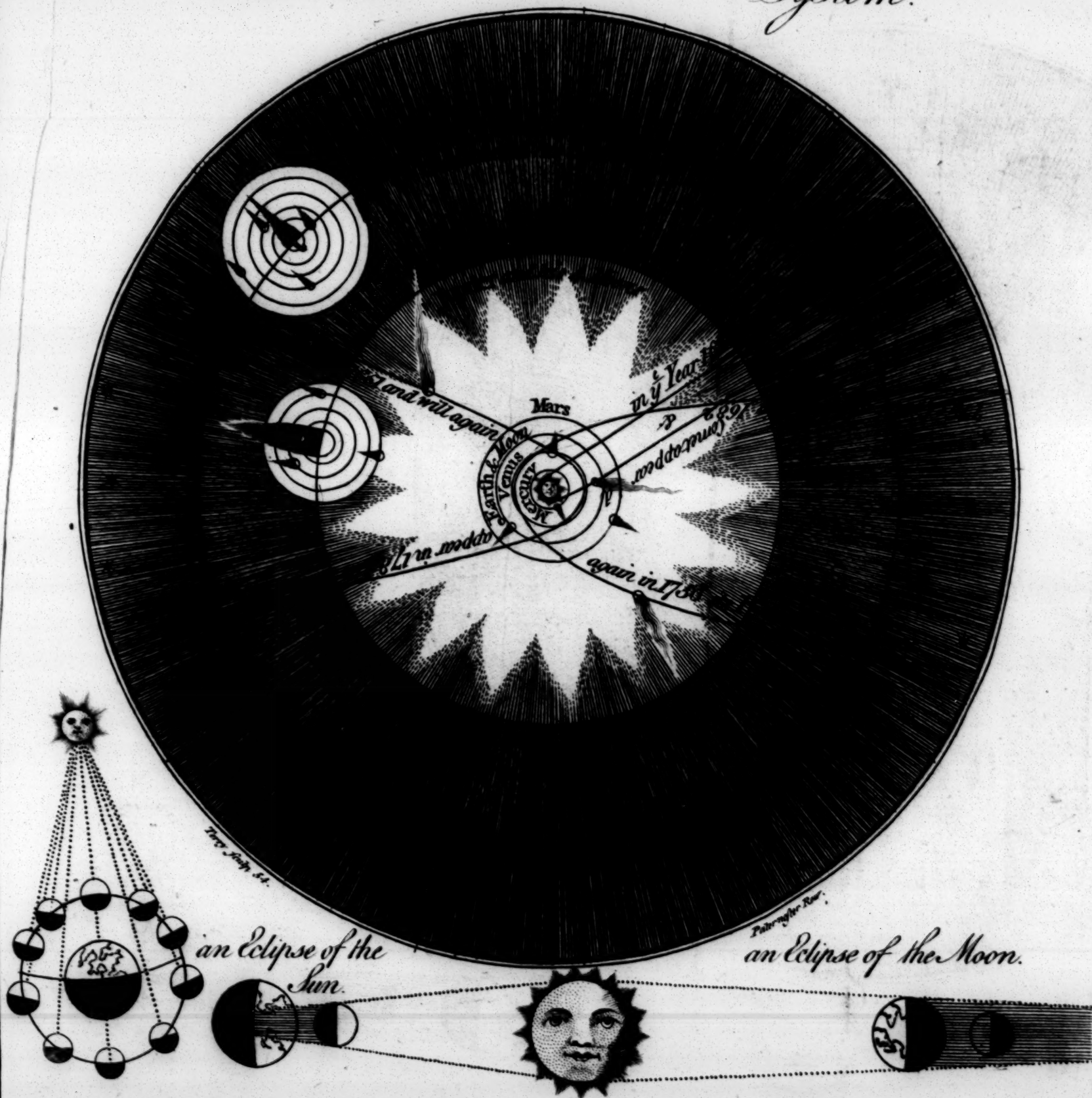
1st. ' The Extent from 105 to 135, will reach from 35 to 45 on the Line of Numbers.'

2dly. ' The Extent from 85 to 75 on the Line of Numbers, will reach from Radius to 61° 56', the Angle B D A on the Line of Sines.'

3dly. ' The Extent from 50 to 30 on the Line of Numbers, will reach from Radius to Angle A D C 36° 53' on the Line of Sines.'

The Solar

System.





A N
I N T R O D U C T I O N

T O T H E A R T O F

N A V I G A T I O N.

BEFORE we begin Navigation, it may not be improper to give the Learner some Idea of the System of the Universe, commonly called the *Solar*, or *Copernican System*, which is as follows :

The *Sun*, that immense and amazing Globe of Fire, the Fountain of Heat and Light of the whole System, is placed near the common Centre of the Orbits of six opaque Spherical Bodies, which make their Revolutions round it in less or more Time, according to their Distance from it.

Mercury is nearest to the Sun, and receives its Light and Heat from it, and revolves round it in an Ellipsis in two Months and twenty-eight Days.

Venus is somewhat higher in the System, and describes its Ellipsis round the Sun in 7 Months and 15 Days, and becomes our Evening and Morning Star by Turns.

The *Earth* is next to Venus, and describes an Ellipsis round the Sun in $365\frac{1}{4}$ Days, or one Year, which being at a greater Distance from the Sun than the former Planets, and therefore receiving less of its Light and Heat, to make up the Deficiency, the wise Author of Nature has caused a secondary Planet called the Moon, to move round it in 27 Days, 12 Hours, and 44 Minutes ; it receives its Light and Heat from the Sun, and reflects it upon the Earth, which in some Measure compensates for the Absence of the Sun in the Winter Seasons in the North and South.

Mars is still higher in the System and takes a larger Circuit, revolving round the Sun in 1 Year, 10 Months, and 22 Days.

Jupiter is the largest of all the Planets, and describes a large Ellipsis round the Sun in 11 Years, 10 Months, 27 Days, and has four Satellites or Moons moving round him, whose Light they receive from the Sun, and reflect it upon him as the Moon does upon the Earth.

Saturn is the most remote of all the Planets, revolving round the Sun in $29\frac{1}{2}$ Years, has 5 Moons which move round him, and is also surrounded with a prodigious Ring or Atmosphere.

The *Fixed Stars* are supposed to be of the same Matter with the Sun, and made for the same Ends ; each of them, the Centre of its

own proper System, having Planets moving round it as our Sun has.

Comets are a Sort of Planets moving round the Sun in Ellipsis so very oblong, that their visible Parts seem to be in a Manner Parabolical, but have such vast Atmospheres about them, and Tails derived from the same, especially when they come near the Sun, as imply them designed for very different Purposes from the other Planets.

Having given a cursory View of the System of the Universe, we shall now consider the Earth a little more particularly; a perfect Knowledge of the Figure and Motion of which, with various real and imaginary Lines upon it, is absolutely necessary in the Art of Navigation.

The *Land* and *Water* of this Earth or Planet upon which we live, make a Composition of a Spherical Form, or rather an Oblate Figure, called the Terraqueous Globe, which turns once round its Axis in 24 Hours, from West to East, and thereby causing all the heavenly Bodies to revolve apparently from East to West in the same Time, making the Vicissitudes of Day and Night; and this Earth, together with its Moon, moves round the Sun in 1 Year, or 365 Days, 6 Hours nearly, producing the Seasons of the Year, *Winter*, *Summer*, *Autumn*, and *Spring*.

That the Earth is round, or nearly so, will appear, not only from the circular Shadow it has upon the Moon when that Body happens to be eclipsed by it, but also from the very Appearance of the Sea; and the many Observations made by Persons standing upon the Shore, and viewing a Ship departing from the Port; they first lose Sight of the Bottom of the Vessel, whilst they can still see the Rigging and Flags at the Tops; but as the Ship recedes farther, they lose Sight of those also, as if the Whole were sunk into the Deep. Likewise, in a Ship making to Land the Mariners first descry the Tops of Steeples, Trees, &c. pointing above the Water; next, they see the Buildings themselves; and lastly the Shore, which can only be the Effects of the Earth's Rotundity.

Its being a Globe, is also confirmed by the many Voyages which have been made round it, from East to West: First by Magellan's Ship in the Year's 1519, 1520, 1521, in 1124 Days; by Sir Francis Drake in the Years 1577, 1578, 1579, 1580, in 1056 Days; by the late Lord Anson, in 4 Years; and lately by the Captains Byron, Carteret, Cook, and Clark, accompanied with several able Mathematicians and Naturalists, whose Observations and Discoveries do Honour to this Nation, as well as greatly contribute to the Improvement of Geography and Navigation, they having discovered many Islands in the South Seas hitherto unknown to Europeans.

The little Unevennesses of the Earth's Surface, arising from the Hills and Vales, is no material Objection to its being considered as round;

round; since the highest Hill or Mountain bears not so great a Proportion to the Bulk of the Earth itself, as the little Risings upon the Coat of an Orange, bear to the Bigness of that Fruit.

In order to describe the Position of Places, Geographers have found it necessary to imagine certain Circles drawn upon the Surface of the Earth; to which they have given the Names of *Equator*, *Meridian*, *Horizon*, *Parallels of Latitude*, &c.

I. The *Axis* is a straight Line, imagined to pass through the Centre of the Earth; the extreme Points are the Poles, on which the Earth is supposed to move, one called the *Artic* or *North Pole*, and the other the *Antartic*, or *South Pole*.

II. The *Equator* is a great Circle under the Equinoctial Line in the Heavens, compassing the Earth in the Middle, between the two Poles, and divides it into two equal Parts, called the Northern and Southern Hemispheres: From it the Latitude of Places is reckoned either North or South; and on it are counted the Degrees of Longitude from East to West. This Circle is called *Equator*, because when the Sun comes to it, which is twice a Year, viz. about the 21st of *March*, at his entrance into Aries, and again into Libra about the 23d of *September*, then making equal Day and Night throughout the World.

III. The *Meridians* are Circles which pass through the Poles of the Earth, the Zenith and Nadir; crossing the Equator at Right Angles, and divide the Earth into two equal Parts, one East and the other West; and is so called, because, when the Sun comes to the Meridian of any Place, it is then Noon or Mid-day. They are infinite in Number; for all Places from East to West have their several Meridians; of these one is called the *first* or *chief Meridian*, from which the Longitude of Places is reckoned; it is of special Note and Use but variously placed by Geographers, some placing it at London, others at Paris, Teneriff, &c. and is divided into twice 90 Degrees, numbered from the Equator towards each Pole ending in 90 Degrees. And since the Earth turns once round its Axis in 24 Hours, every Point upon its Surface describing a Circle of 360 Degrees in that Time, therefore any Place lying 15 Degrees to the East of us, has the Sun upon its Meridian one Hour sooner; or it is Twelve o'Clock with the Eastermost, when it is Eleven with us; and any Place 15 Degrees to the Westward of us, has the Sun one Hour after us.

IV. *Latitude* is the nearest Distance of any Place from the Equator, it is measured on an Arch of the Meridian intercepted between the Place and the Equator, and therefore can never exceed 90 Degrees. It takes its Name according as the Place is situated, either North or South of the Equator; therefore all Places that lie at the same Distance from, and on the same Side of the Equator, are said to be under the same Parallel of Latitude. Whence it follows, that if a Ship sails from a North Latitude directly North, or in a

E

South

South Latitude directly South, she increases her Latitude equal to the Distance sailed; and if a Ship sails in North Latitude Southerly, or in South Latitude Northerly, she decreases her Latitude, because she sails nearer to the Equator; from whence the Latitude is counted upon the Meridian: But if a Ship sails from a South Latitude into a Northerly one, or from a North Latitude into a Southerly one, from the Difference of Latitude subtract the Latitude left, and the Remainder will be the Latitude come to; and of a different Name with the Latitude left.

Parallels of Latitude are Circles Parallel to the Equator.

The Difference of Latitude is an Arch of the Meridian contained between the two Parallels of Latitude; or it is the least Distance of the Parallels of Latitude of two Places: shewing how far one of them is to the Northward or Southward of the other, and can never exceed 180 Degrees.

V. *The Longitude* of any Place on the Earth is expressed by an Arch of the Equator, shewing the East or West Distance of the Meridian of that Place, from some fixed Meridian, where Longitude is reckoned to begin.

Difference of Longitude is an Arch of the Equator, intercepted between the Meridians of two Places shewing how far one of them is to the Eastward or Westward of the other.

As Longitude begins at the Meridian of some Place, and is counted from thence both Eastward and Westward, till it meets at the same Meridian on the opposite Point, therefore the Difference of Longitude can never exceed 180 Degrees.

VI. *The Horizon* is that apparent Circle which limits or bounds the View of a Spectator on the Sea, or an extended Plain; the Eye of the Spectator being always supposed the Centre of his Horizon. Every Part of this Circle is 90 Degrees from the Centre of it over our Heads, which Point is called the Zenith; and the Point of the Heavens opposite to it, or under our Feet, is called the Nadir.

When the Sun or Stars come above the Eastermost Part of the Horizon, they are said to rise; and when they descend the Western Part they are said to set.

When a Ship is under the Equator, both the Poles appear in the Horizon, and in Proportion as she sails towards either, or increases her Latitude, that Pole is seen proportionably above the Horizon, and the other disappears as much; but when a Ship is sailing towards the Equator, or decreases her Latitude, she depresses the elevated Pole; that is, its Distance from the Horizon decreases: consequently the Latitude of a Place is always equal to the Elevation Pole of the above Horizon.

This Circle is represented by the Mariner's Compass, divided into 32 Points or Rhumbs, each $11^{\circ} 15'$.

The

The *Tropics* are two Circles parallel to the Equator, and distant from it 23 Degrees 29 Minutes; that on the North Side of it is called the *Tropic of Cancer*, at which the Sun has its greatest North Declination; then making to us, and all Places in North Latitude, the longest Day and shortest Night, which is about the 21st of June. The other on the South Side is called the *Tropic of Capricorn*, at which the Sun has its greatest South Declination, making then our shortest Day and longest Night, which is about the 22d of December.

The *Polar Circles* are also parallel to the Equator, compassing the Poles of the World at 23 Degrees 29 Minutes Distance; that about the North Pole is called the *Arctic Circle*, and the other is called the *Antarctic Circle*.

These *Tropics* and *Polar Circles* divide the Globe of the Earth into 5 Parts, called *Zones*, of which 3 were accounted by the Ancients to be so intemperate, as to be uninhabitable; the *Zones* are called *Torrid*, *Frigid*, and *Temperate*, that is, 1 *Torrid*, or *Burning Zone*, 2 *Temperate*, and 2 *Frigid* or *Frozen Zones*.

The *Torrid Zone* is all that Space of the Earth and Sea, which lies between the *Tropics* of *Cancer* and *Capricorn*, and is 47 Degrees broad; its Inhabitants see the Shadow of the Sun turn sometimes towards one Pole and sometimes towards the other.

The *Two Temperate Zones* are those Spaces of the Earth and Sea contained between each *Tropic* and the *Polar Circles*; the Inhabitants of the North *Temperate Zone* have their Shadows at Noon fall North, and those of the South *Temperate Zone* have their Shadows at Noon fall South.

The *Two Frigid Zones* are contained between each *Polar Circle* and its Pole; those who inhabit them have their Shadow always running round them, according to the different Motions of the Sun.

Climates are those Tracks of the Earth bounded by imaginary Lines running parallel to the Equator, and of such a Breadth from South to North, that the Length of the Artificial Day in one, surpasses that in the other by Half an Hour.

The Inhabitants of the Earth are distinguished by the several Meridians and Parallels under which they live, and are denominated either *Periæci*, *Antiæci*, or *Antipodes*.

The *Periæci* are those People of the Earth who live under the same Parallels, but opposite Meridians.

The *Antiæci* are those People of the Earth who live under the same Meridians, but opposite Parallels.

The *Antipodes* are situated directly opposite to each other, the Feet of the one directly against the Feet of the other, lying under opposite Parallels and opposite Meridians. It is Midnight with one when it is Noon Day with the other; the longest Day with the one is the shortest with the other; the Length of the Day with the one

is equal to the other's Night; and the Seasons are opposite, being Summer with the one when it is Winter with the other.

The *Real Parts* are Earth and Water, generally divided into four Parts or Quarters, called *Europe*, *Asia*, *Africa*, and *America*; each of these, and consequently the whole Globe, is divided into Continents, Islands, Seas, &c.

A *Continent* is a great Quantity of Land not divided by the Sea, wherein are several Empires, Kingdoms, and Countries conjoined, as *Europe*, *Asia*, and *Africa*, is one Continent, and *America* another.

An *Island* is a Part of the Earth that is environed or encompassed round by the Sea, as *Great Britain* and *Ireland*.

A *Peninsula* is a Part of Land almost surrounded with Water, save one narrow Neck of Land which joins the same to the Continent.

An *Isthmus* is a narrow Neck of Land joining the Peninsula to the Continent, by which the People may pass from one to the other.

A *Promontory* is a high Part of Land, stretching itself into the Sea, the Extremity of which is called a Cape or Headland.

A *Mountain* is a rising Part of dry Land over-topping the adjacent Country, and appearing first at a Distance.

The Earth being encompassed with Water, whose Washings in surrounding the dry Land, cut and shape many winding Bays, Creeks, and meandering Inlets, and extending itself round them all, is but one continued Ocean.

An *Ocean* is a vast Collection of Salt Water, separating Continents from one another, and washing their Borders or Shores.

A *Sea* is Part of the Ocean, to which we must sail through some Strait, as the *Mediterranean*, and *Baltic Seas*.

A *Strait* is a narrow Part of the Ocean lying between two Shores, and opening a Way into some Sea, as the Straits of *Gibraltar* that lead into the Mediterranean Sea, and the Sound which leads into the Baltic Sea.

A *Creek* is a small narrow Part of the Sea or River, that goes up but a little Way into the Land.

A *Bay* is a great Inlet of the Land, as the *Bay of Biscay* and the *Bay of Mexico*; otherwise a Bay is a Station or Road for Ships to anchor in.

A *River* is a considerable Stream of Water issuing out of one or various Springs, and continually gliding along in one or more Channels, till it discharges itself into the Ocean: The lesser Streams are called *Rivulets*.

A *Lake* is that which continually retains and keeps Water in it, as the *Lake Zair*, in *Africa*, and *Nicaragua*, in *America*.

A *Gulph* is a Part of the Ocean or Sea, contained between two Shores, and is every where environed by Land, except its Entrance, where it communicates with other Bays, Seas, or Oceans.

There

There are five Oceans, namely, the *Northern*, the *Atlantic*, the *Pacific*, the *Indian*, and the *Southern*.

The *Atlantic Ocean* is usually divided into two Parts, one called the *North Atlantic Ocean*, and the other the *South Atlantic* or *Ethiopic Ocean*.

The *Northern Ocean* stretches to the Northward of *Europe*, *Asia*, and *America*, towards the North Pole.

The *Atlantic Ocean* lies between the Continents of *Europe*, and *Africa*, on the East, and *America* on the West.

That Part of the North Atlantic Ocean lying between *Europe* and *America*, is frequently called the Western Ocean.

The *Pacific Ocean*, or, as it is sometimes called, the *South Sea*, is bounded by the Western and North west Shores of *America*, and by the Eastern and North-east Shores of *Asia*.

The *Indian Ocean* washes the Shores of the Eastern Coasts of *Africa*, and the South of *Asia*, and is bounded on the East by the *Indian Islands* and the Southern Continent.

The *Southern Ocean* extends to the Southward of *Africa* and *America* towards the South Pole.

NAVIGATION.

THE great End and Business of Navigation is to instruct the Mariner how to conduct a Ship through the wide and pathless Ocean, to the remotest Parts of the World, the safest and shortest Way, in Passages navigable.

For the due and regular Performance of which are requisite—a perfect Knowledge of the Figure and Motion of the Earth, the various, real, and imaginary Lines upon it, so as to be able to ascertain the real Distance and Situation of Places with respect to one another, with the Use of the several Instruments made Use of in measuring the Ship's Way; such as the Log, Half-minute Glass, Quadrant, to take the Altitude of the Sun and Stars; Compass, to represent the sensible Horizon; and Azimuth Compass, to take the Azimuth or Amplitude of the Sun, in order to know the Variation of the magnetic Needle; Maps or Charts of the Seas and Lands, together with the Depth of Water, and the Times and Settings of the Tides upon the Coasts he may have Occasion to approach near; a competent Knowledge of Currents; of the Mould and Trim of the Ship, and the Sail she bears, that so due Allowance may be made for Leeway: By Help of these, and Skill in the Navigator, he may know at all Times the Place the Ship is in, which Way he must steer, and how far, to gain his intended Port.

Notwithstanding

Notwithstanding what has been said, it may not be improper here to observe, that,

As Latitude is counted from the Equator upon an Arch of the Meridian, North and South, the Difference of Latitude between two Places, both North or both South, is found by subtracting the less Latitude from the greater; but if one Latitude be North and the other South, the Difference is found by adding both Latitudes together.

Consequently, if a Ship in North Latitude sails Northerly, or in South Latitude Southerly, she increases her Latitude; but in North Latitude sailing Southerly, or in South Latitude sailing Northerly, she decreases her Latitude; because she sails nearer to the Equator, from whence the Latitude is reckoned.

Wherefore in North Latitude sailing Northerly, or in South Latitude sailing Southerly, the Difference of Latitude added to the Latitude left, gives the Latitude in.

In North Latitude sailing Southerly, or in South Latitude sailing Northerly, the Difference of Latitude subtracted from the Latitude left, gives the Latitude in.

When the Latitude decreases, and the Difference of Latitude is greater than the Latitude sailed from, subtract the Latitude left from the Difference, and the Remainder will be the Latitude in, and of a different Name; for it is plain, in this Case, that the Ship has crossed the Equator.

As the Longitude is counted from the first Meridian East and West, until it comes to the opposite Meridian, therefore it cannot exceed 180 Degrees.

The Difference of Longitude between two Places, being both East or West, is found by subtracting the less Longitude from the greater; but if one be in East Longitude and the other in West, their Sum is the Difference of Longitude.

Therefore in East Longitude sailing Easterly, or in West Longitude sailing Westerly, the Difference of Longitude added to the Longitude left, gives the Longitude in.

In East Longitude sailing Westerly, or in West Longitude sailing Easterly, the Difference of Longitude subtracted from the Longitude left, gives the Longitude in.

When a Ship sails East or West until she passes the opposite Meridian, or 180 Degrees, she changes her Longitude, or comes into a Longitude of a different Name.

What has been said, will be rendered familiar to the Learner by the following Examples:

EXAMP. I.

EXAMP. I. What is the Difference of Latitude between London in Latitude $51^{\circ} 32' N.$ and Rome in Latitude $41^{\circ} 54' N.$

From London's Lat.	51 : 32 N.
Subtract Rome's Lat.	41 : 54 N.
Rem. the Diff. of Lat.	9 : 38 N.
	60
Diff. in Miles	578

EXAMP. III. Required the Difference of Latitude between Cape Finisterre and Cape Rogue in South America?

Cape Finisterre's Lat.	43 : 13 N.
Cape Rogue's Lat.	5 : 00 S.
Diff. of Lat.	48 : 13
	60
Diff. in Miles	2893

EXAMP. II. A Ship from Latitude $29^{\circ} 17' S.$ fails Southward until her Difference of Latitude be 374 Miles, what Latitude is she come to?

Latitude failed from	29 : 17 S.
Diff. of Lat. $374 \div 60 =$	6 : 14 S.
Lat. in	35 : 31 S.

EXAMP. IV. A Ship from Latitude $8^{\circ} 25' N.$ fails South 600 Miles, what Latitude is she in?

From Diff. of Lat. 600 Miles, or	10 : 00 S.
Sub. Lat. left	8 : 25 N.
Diff. Lat. in	1 : 35 S.

In the last Example it is plain, that as the Difference of Latitude is more than the Latitude left, the Ship must have crossed the Equator, and consequently come into South Latitude.

Note. When one of the Places has no Latitude, or is on the Equator, then the Lat. of the other Place is their Difference of Latitude.

EXAMP. V. What is the Difference of Longitude between Cape Finisterre and Antigua?

Cape Finisterre's Long.	9 : 26 W.
Antigua's Long.	61 : 53 W.
Diff. of Long.	52 : 27
	60
Diff. of Lon. in Miles	3147

EXAMP. VI. A Ship from Cape Charles in Virginia, fails Westward till her Difference of Longitude be 400 Miles, what Longitude is she in?

Cape Charles' Long.	76 : 7 W.
Diff. of L. 400 Miles $=$	6 : 40 W.
Long. in	82 : 47 W.

EXAMP. VII.

EXAMP. VII. What is the Difference of Longitude between Barcelona and Lisbon?

Barcelona's Long.	2 : 18 E.
Lisbon's Long.	9 : 3 W.
Diff. of Long.	<u>11 : 21 W.</u>

EXAMP. IX. What is the Difference of Longitude between the N. E. Point of Japan and St. Christopher's?

N. Po. of Japan's Lat.	140 : 25 E.
St. Christ. Long.	62 : 50 W.
Exceeds 180° 00'	<u>203 : 15</u> <u>360 : 00</u>
Diff. of Long.	<u>156 : 45</u>

EXAMP. VIII. A Ship from 15° 40' E. Long. sails Westward till her Diff. of Long. be 27° 15', what Long. is she in?

Long. left	15 : 40 E.
Diff. of Long.	27 : 15 W.
Long. in	<u>11 : 35 W.</u>

EXAMP. X. A Ship from Longitude 160° 20' W. sails Westward until she differs her Long. 41° 20', what Long. is she in?

Long. left	160 : 20 W.
Diff. of Long.	41 : 20 W.
	<u>208 : 40</u> <u>360 : 00</u>
Long. in	<u>158 : 20 E.</u>

Here it is plain, that the Ship has crossed the opposite Meridian, and therefore has come into a Longitude of a different Name.

In sailing due North or South, the Ship changes her Latitude only; and sailing East or West her Longitude; but sailing upon any other Course, she must change both Latitude and Longitude.

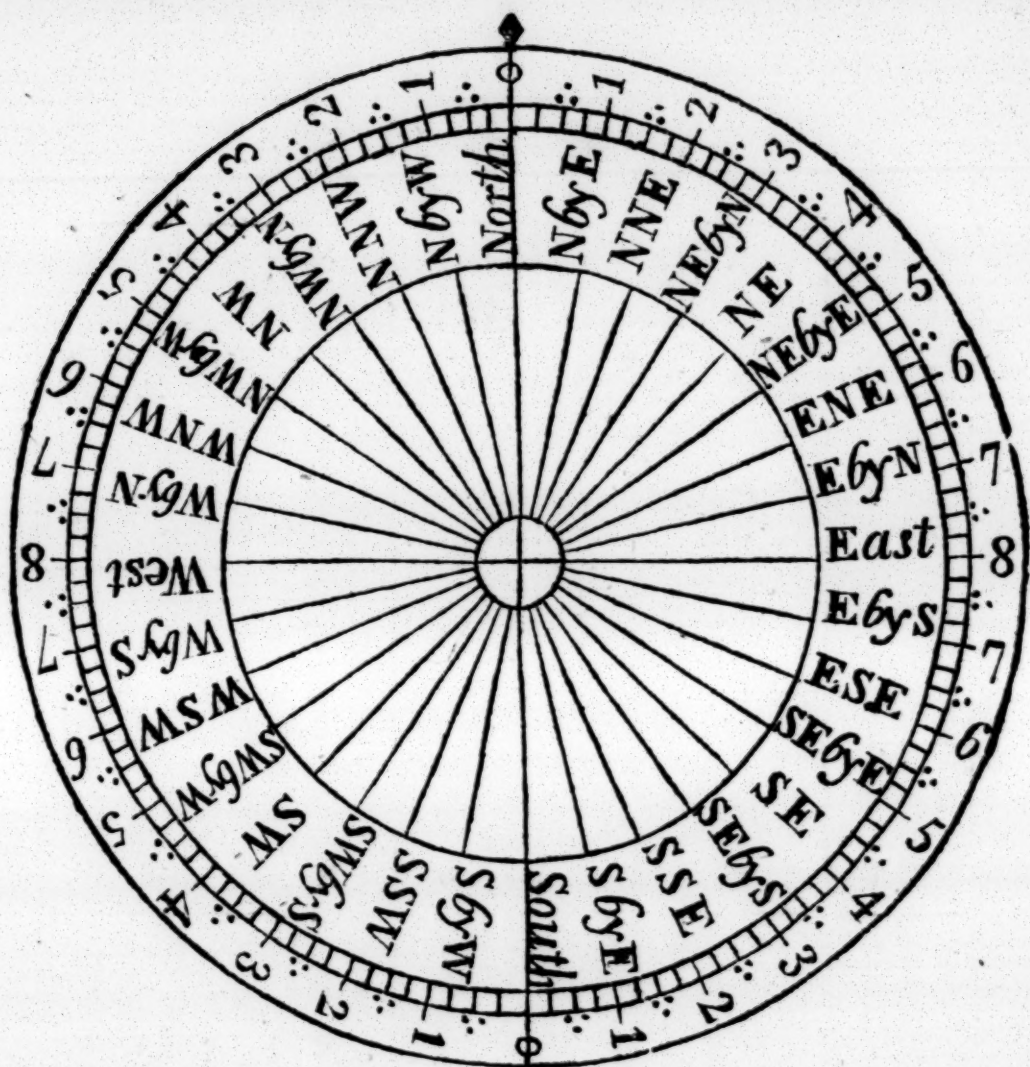
Easting or Westing in Plain Sailing is called Departure or Meridian Distance.

The Instrument used in measuring a Ship's Way at Sea, is the Log.

Ships at Sea are directed from one Place to another by Means of an Instrument called the Mariner's Compass.

The Mariner's Compass is an Artificial Representation of the Horizon of every Place by the Means of a circular Piece of Paper, called a Card, divided like the Horizon into Degrees and Points, which are called Rhumbs. Now the Card being properly fixed to a Piece of Steel, called the Needle, that has been touched with a Loadstone (whose Property is such as to cause one End of the Needle so touched, to point towards the North when turning freely on something supporting it) all the Points of the Card will be directed towards the corresponding Points of the Horizon.

THE MARINER'S COMPASS.



Hence it follows, that in every Place the North Point of the Card shews the Position of the Meridian at that Place, and some one Rhumb or Point of the Card will coincide with, or be directed along the Track that makes any given Angle with the Meridian; consequently, by the Help of the Card or Compass, a Ship may be kept in any proposed Track or Course.

A Rhumb Line, or Point, is a Right Line drawn from the Center of the Compass to the Horizon, and is named from that Point of the Horizon it falls in with.

The Course is the Angle which any Rhumb Line makes with the Meridian, and is sometimes reckoned in Degrees, and sometimes in Points of the Compass; so that if a Ship sails upon the second Rhumb or N. N. E. the Course is 22 Degrees 30 Minutes: And so for any other, as in the following Table, which the Learner should be so well acquainted with, or the Compass, as to be able readily to tell how many Points any Courses or Rhumbs are distant from the Meridian, or from the Parallel.

A Table of the Angles which every Point of the Compass makes with the Meridian.

North.	South.	Points.	D. M.	North.	South.
		$\frac{1}{4}$	2.49		
		$\frac{1}{2}$	5.37		
		$\frac{3}{4}$	8.26		
N. by E.	S. by E.	1	11.15	N. by W.	S. by W.
		$\frac{1}{4}$	14. 4		
		$\frac{1}{2}$	16. 52		
N. N. E.	S. S. E.	1	19.41	N. N. W.	S. S. W.
		$\frac{3}{4}$	22.30		
		2	25.19		
		$\frac{1}{4}$	28. 7		
		$\frac{1}{2}$	30.56		
N E by N	S. E. by S.	$\frac{3}{4}$	33.45	N. W. by N.	S. W. by S.
		3	36.34		
		$\frac{1}{4}$	39.22		
		$\frac{1}{2}$	42. 11		
N. E.	S. E.	$\frac{3}{4}$	45. 0	N. W.	S. W.
		4	47.49		
		$\frac{1}{4}$	50.37		
		$\frac{1}{2}$	53.26		
N E by E	S. E. by E.	$\frac{3}{4}$	56.15	N. W. by W.	S. W. by W.
		5	59. 4		
		$\frac{1}{4}$	61.52		
		$\frac{1}{2}$	64.42		
E. N. E.	E. S. E.	$\frac{3}{4}$	67.30	W. N. W.	W. S. W.
		6	70.19		
		$\frac{1}{4}$	73. 7		
		$\frac{1}{2}$	75.56		
E. by N.	E. by S.	$\frac{3}{4}$	78.45	W. by N.	W. by S.
		7	81.34		
		$\frac{1}{4}$	84.22		
		$\frac{1}{2}$	87.11		
	East.	$\frac{3}{4}$	90. 0	West.	
		8			

P L A N E S A I L I N G.

PLANE SAILING is the Art of Navigating a Ship upon Principles deduced from the Notion of the Earth's being an extended Plane; and is no more than the Application of Plane Trigonometry to the Solution of the several Variations, or Cases; where the Hypothenufe, or longest Side, is always the Rhumb that the Ship sails upon.

The Perpendicular is the Difference of Latitude counted on the Meridian, and the Base the Departure: which is either Easting or Westing, counted from the Meridian.

The Angle opposite the Base is the Course, or Angle, that the Ship makes with the Meridian; and the Angle opposite the Perpendicular is the Complement of the Course, which being taken together, make always eight Points or Rhumbs, which is 90 Degrees.

In constructing Figures relating to a Ship's Course, let the upper Part of the Paper, or what the Figure is drawn upon, always represent the North; the lower Part will be the South; the Right Hand East; and the Left West.

Draw the North and South Line to represent the Meridian of the Place the Ship sails from; then if the Ship's Course is to the Southward, mark the upper End of the Line for the Place sailed from; but if the Course is Northward, mark the lower End for that Place.

When the Course is Easterly, describe the Arch, and lay off the Course and Departure on the Right Hand Side of the Meridian, but when Westerly on the Left Hand Side.

When the Course is given in Degrees, the Degrees expressing it must be taken from the Line of Chords; but when in Points from the Line of Rhumbs; and is always to be laid off upon the Arch, beginning at the Meridian.

When the Course is given in Points, it may be set down with its corresponding Logarithm in Points in the Calculation, as found in the first Page of the Logarithms, without reducing it into Degrees, as it seems altogether unnecessary.

In all Cases, wherever the Complement Course, or Co-sine, &c. is used, the Degrees or Points put down is the Course itself; yet the Logarithm belonging to the Complement, or Co sine, &c. of that Course is taken.

C A S E I .

Course and Distance sailed given, to find the Difference of Latitude and the Departure from the Meridian.

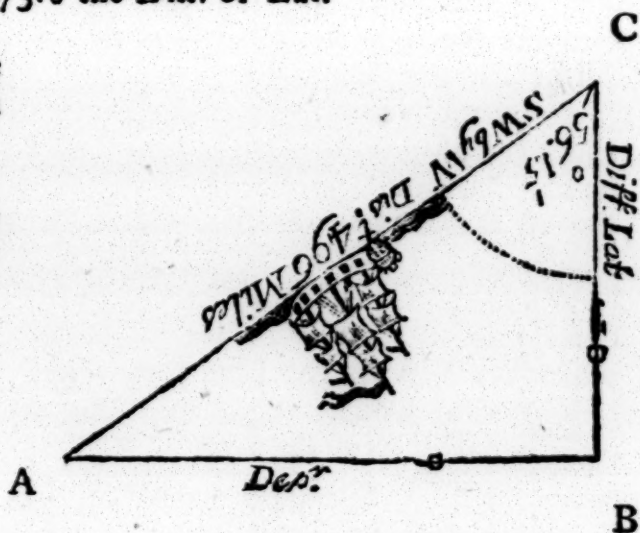
Suppose a Ship from the Lizard in the Latitude of $49^{\circ} 57'$ North, sails S. W. by W. 496 Miles ; required the Latitude come to, and Departure from the Meridian ?

By P R O J E C T I O N .

Draw the Meridian or Difference of Latitude, with the Chord of 60° in your Compasses, and one Foot in C, describe an Arch, take $56^{\circ} 15'$ or 5 Points in your Compasses, and lay off that Distance upon the Arch from B C towards C A ; through the Point where it cuts, draw the Distance C A ; upon which set off 496 : from A let fall the Perpendicular A B the Departure, and it is done ; for A B being measured on the same Scale that A C was, will give the Departure 412,4, and B C 275.6 the Diff. of Lat.

The Calculation is the same as Problem I. in TRIGONOMETRY.

I shall work this Case by making each Side Radius.



By making the Distance Radius it will be by AXIOM I.

The Course 5 Points = $56^{\circ} 15'$			The Co-Course 3 Points $33^{\circ} 45'$		
To find the Departure.			To find the Difference of Lat.		
As Radius	90'	10,00000	As Radius	90'	10,00000
Is to the Distance	496	2,69548	Is to the Dist.	496	2,69548
So is Sine Co-sine 5 Pts.		9,91985	So is Co-sine Course 3 Pts.		9,74474
		12,61533			12,44022
		10,00000			10,00000
To the Departure	412.4	2,61533	To the Diff. of Lat.	275,6	2,44022
					Now

Now as the Ship is in North Latitude sailing Southerly from the Latitude left

Take the Difference of Latitude 275,6 = 49° 57' N.
4 36 S.

Gives the Latitude in 45 21 N.

And the Departure from the Meridian is 412,4 Miles.

By making the Departure Radius it will be,

To find the Departure.

As Co-Sec. Course 5 Pts. 10,08015
Is to the Dist. 496 2,69548
So is Radius 8 Pts. 90° 10,00000

12,69548
10,08015

To the Departure 412,4 2,61533

To find the Diff. of Lat.

As Co-Sec. Course 5 Pts. 10,08015
Is to the Dist. 496 2,69548
So is Co-Tan. Course 5 Pts. 9,82489

12,52037
10,08015

To the Diff. of Lat. 275,6 2,44022

By making the Difference of Latitude Radius it will be,

To find the Departure.

As Sec. Course 5 Pts. 10,25526
Is to the Dist. 496 2,69548
So is Tang. Course 5 Pts. 10,17511

12,87059
10,25526

To the Dep. 412,4 2,61533

To find the Difference of Latitude.

As Sec. Course, 5 Pts. 10,25526
Is to the Dist. 496 2,69548
So is Radius 8 Pts. 90° 10,00000

12,69548
10,25526

To the Diff. of Lat. 275,6 2,44022

Here all the three Sides are made Radius, to find the Difference of Latitude and Departure; therefore, the Learner may make which Side Radius he pleases; but as for my Part, I shall make the first, where the Distance is made Radius, whenever the Course is given.

Though this Method of working by Logarithms is certain, yet the same may be wrought by Gunter's Scale and Compasses, much more expeditious; and exact enough in the Practice of Navigation.

NOTE. When the Course is given in Points, make Use of the Lines marked Sine Rhumbs, and Tangent Rhumbs on the upper Side of the Scale; when in Degrees make Use of the Lines marked Sine and Tangent.

By

By G U N T E R.

Now to perform the last Case, extend from Radius or 8 Points to 5 Points on the Line marked S R ; that Extent will reach from the Distance 496 to the Departure 412.4 on the Line of Numbers.

2dly. 'Extend from Radius or 8 Points to 3 Points, (the Complement of the Course) on the Line S R ; that Extent will reach from the Distance 496 to the Difference of Latitude 275.6 on the Line of Numbers.'

Thus may all the Operations be performed in the several Cases of Navigation.

By this Case is calculated the Tables of Latitude and Departure for every Degree, Point, and Quarter Point of the Mariner's Compass to the Distance of 300 Miles, which is of excellent Use in working Days Works at Sea, and may be applied both to Middle Latitude and Mercator's Sailing, as shall be shewn hereafter; we shall only proceed now to the Working of the last Case by the Table of Diff. of Latitude and Departure, which is called Working

By I N S P E C T I O N.

Find the given Course at the Top or Bottom of the Tables, either among the Points or Degrees, and in that Page, and right against the Distance taken in its Column, stand the Difference of Latitude and Departure in their Columns.

Thus the Course is S. W. by W. or 5 Points, which is found at the Bottom of the Table of Difference of Latitude and Departure for Points; and as the Distance 496 is too great to be found in the Tables, divide it by 2, (or any other convenient Number) and that gives 248, which look for in the Distance Column, and right against it stands 137.8 for the Difference of Latitude, and 206.2 for the Departure, which being doubled, (because divided by 2) gives 275.6 for the Difference of Latitude, and 412.4 for the Departure, the same as before. Any of these Methods will do, but the last is chiefly practised at Sea.

C A S E II.

Course and Difference of Latitude given, to find the Distance run, and Departure from the Meridian.

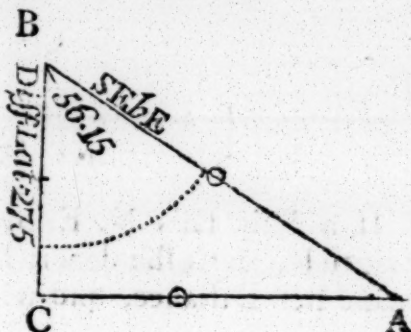
If a Ship runs S. E. by E. from $1^{\circ}45'$ North Latitude, and then by Observation is in $2^{\circ}50'$ South Latitude, what is her Distance and Departure?

Now

Now in this Case, as the Ship has crossed the Equator, therefore the Latitude $1^{\circ} 45' N.$ added to $2^{\circ} 50' S.$ is $4^{\circ} 35'$, which multiplied by 60 gives 275 Miles for the Difference of Latitude.

Constructed the same as Problem VII. in Geometry.

Draw $BC=275$, and BA making an Angle with $BC=5$ Points, or $56^{\circ} 15'$; upon C erect the Perpendicular CA to join BA in A , and it is done, then will $CA=112$, and $AB=496$.



By making the Distance AB Radius, it will be,

Course S. E. by E. 5 Pts. $=56^{\circ} 15'$ Complement 3 Points $=33^{\circ} 45'$

To find the Departure. To find the Distance.

As Co Sine Course 5 Pts. 9.74474	As Co-Sine Course 5 Pts. 9.74474
Is to the Diff. of Lat. 275 2.43933	Is to the Diff. of Lat. 275 2.43933
So is S. Course 5 Points 9.91985	So is Radius 10.00000
12.35918	12.43933
9.74474	9.74474

To the Departure 411.6 2.61444 To the Distance 495 2.69459

Hence the Ship's Distance run is 495 Miles, and her Departure from the Meridian is 411.6 Easterly.

By GUNTER'S RULE

Extend from 3 to 5 Points on the Line marked S^R , that Extent will reach from the Difference of Latitude 275 to the Departure 411.6 on the Line of Numbers.

2dly, Extend from Radius or 8 Points to 3 Points, that Extent will reach from the Difference of Latitude 275 to the Distance 495 on the Line of Numbers.

By INSPECTION

Find the Course among the Points or Degrees, and the Difference of Latitude in its Column, right against which stand the Distance and Departure in their Columns.

Now as the Difference of Latitude 275 is too great to be found in the Tables, I divide it by 5, and that gives 55, which I find over 5 Points, in the Latitude Column; against that stands 99

for the Distance, and 82.3 for the Departure, which being multiplied by 5 is 495 the Distance, and 411.5 the Departure, nearly as before.

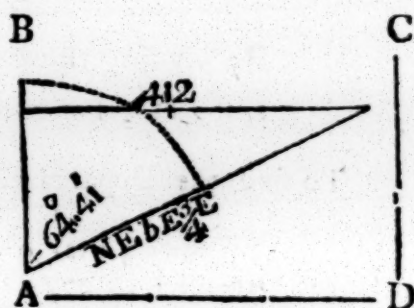
C A S E III.

Course and Departure from the Meridian given, to find the Distance and Difference of Latitude.

If a Ship sails N. E. by E. $\frac{3}{4}$ E. from a Port in $3^{\circ} 15'$ South Latitude, until she depart from her first Meridian 412 Miles, I demand her Distance, and what Latitude she is in?

Constructed the same as Problem VII. in Geometry.

Draw A D, upon which erect the Perpendicular A B; draw the Line A C making an Angle with A B = the Course $5\frac{3}{4}$ Points or $64^{\circ} 41'$. At the Distance of 412 Miles draw D C parallel to A B to cut A C in C; through the Point C draw B C parallel to A D to cut the Meridian A B; then will A C be the Distance 456, and A B the Diff. of Lat. 195, nearly.



By making the Distance A C Radius, it will be,

The Course $5\frac{3}{4}$ Points = $64^{\circ} 41'$ The Complement $2\frac{1}{4}$ Pts. = $25^{\circ} 19'$

To find the Diff. of Lat.

To find the Distance.

As S. Course $5\frac{3}{4}$ Pts. 9.95616
Is to the Departure 412 2.61490
So is Co-Sine Cou. $5\frac{3}{4}$ Pts. 9.63099
 12.24589
 9.95616

As S. Course $5\frac{3}{4}$ Pts. 9.95616
Is to the Departure 412 2.61490
So is Radius 10.00000
 12.61490
 9.95616

To the Diff. of Lat. 194.8 2.28973

To the Distance 455.8 2.65874

From the Latitude left

Subtract the Difference of Latitude 195 Miles, or

$3^{\circ} 15' S.$
 $3 \quad 15 N.$

The Rem. being nothing, shews the Ship is on the Equator. 0.00

By G U N T E R.

'Extent from $5\frac{3}{4}$ Points to $2\frac{1}{4}$ on the Line marked S R, that Extent will reach from the Departure 412 to the Difference of Latitude 194.8 on the Line of Numbers.'

2dly. 'Extend from Radius to $5\frac{3}{4}$ Points, that Extent will reach from the Departure 412 to the Distance 455.8 Miles.'

By INSPECTION.

Find the Course either among the Points or Degrees, and the Departure in its Column, right against which stand the Distance and Difference of Latitude in their respective Columns.

Thus, with the Course $5\frac{3}{4}$ Points, and $\frac{1}{2}$ the Departure, I find 228 for the Distance, and 97.5 for the Difference of Latitude, which being doubled, gives the Distance 456, and the Difference of Latitude 195, as before.

CASE IV.

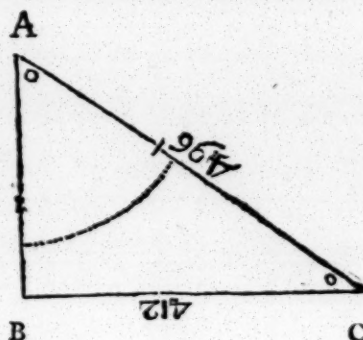
Distance and Difference of Latitude given, to find the Course and Departure.

Suppose a Ship sails 496 Miles, between the South and the East, from a Port in $2^{\circ} 48'$ South Latitude, and then by Observation is in $7^{\circ} 23'$ South Latitude; what Course has she steered, and what Departure has she made?

From the Latitude by Observation $7^{\circ} 23'$, take $2^{\circ} 48'$ the Latitude left, the Remainder $4^{\circ} 35'$ multiply by 60 = 275, the Miles or Minutes of Difference of Latitude.

Constructed as Problem VIII in Geometry.

Draw the Meridian $AB = 275$; upon B erect the Perpendicular BC ; take 496 in your Compasses, and with one Foot on A, lay the other on the Line BC ; join A and C; then will BC be the Departure 412 and the Angle BAC , the Course = $56^{\circ} 10'$ or 5 Points nearly.



To find the Course.

To find the Departure.

As the Distance 496	2.69548
Is to Radius	10.00000
So is the Diff. of Lat. 275	2.43933
	12.43933
	2.69548

As Radius	10.00000
Is to the Distance 496	2.69548
So is S. Course $56^{\circ} 20'$	9.92027
	12.61575
	10.00000

To Co-sine Cou. $56^{\circ} 20'$ 9.74385

To the Departure 412.8 2.61575

Hence the Course is S. E. by E. and the Dep. 412.8 Miles.

H

By

By G U N T E R.

' The Extent from the Distance 496 to the Difference of Latitude 275 on the Line of *Numbers*, will reach from Radius or 90° to $33^\circ 40'$ the Co-Course on the Line of Sines.'

' And the Extent from Radius to $56^\circ 20'$ on the Line of Sines, will reach from the Distance 496 to the Departure 412.8 on the Line of Numbers.'

By I N S P E C T I O N.

Seek in the Tables till against the Distance, taken in its Column, be found the given Difference of Latitude in one of the following Columns; and adjoining to it stands the Departure; which, if less than the Difference of Latitude, the Course is found at the Top, but if greater the Course is found at the Bottom.

Now with half the Distance 248 and half the Difference of Latitude 137.5, look in the Tables till they are found to agree in their respective Columns, which they do nearly over 5 Points, against which stands 206.2 for the Departure, and being doubled, gives 412.4, nearly as before.

C A S E V.

Distance and Departure given, to find the Course and Difference of Latitude.

Admit a Ship sails 496 Minutes between the North and West from the Island *Bermudas* in Lat. $32^\circ 25'$ North, until her Dep. is 412 Miles, what Course has she steered, and what Lat. is she in?

Note. This Case is constructed much the same as the last.

To find the Course.

To find the Diff. of Lat.

As the Distance 496	2.69548	As Radius	10.00000
Is to Radius	10.00000	Is to the Distance 496	2.69548
So is Departure 412	2.61490	So is Co-Sine Co. $56^\circ 10'$	9.74568
	12.61490		12.44116
	2.69548		10.00000
To the S. of Cou. $56^\circ 10'$	9.91942	To the Diff. of Lat. 276.1	2.44116

Hence the Course is N. $56^\circ 10'$ W. or N. W. by W;

To

To the Latitude failed from $32^{\circ} 25'$ add the Difference of Latitude 276, or $4^{\circ} 36'$, gives $37^{\circ} 1'$, the Latitude the Ship is in.

By G U N T E R:

' Extend from the Distance 496 to the Departure 412 on the Line of Numbers, that Extent will reach from Radius to the Course $56^{\circ} 10'$ on the Line of Sines.'

2dly. ' Extend from Radius to the Complement of the Course $33^{\circ} 50'$ on the Line of Sines, that Extent will reach from the Distance 496 to the Diff. of Lat. 276 on the Line of Numbers.'

By I N S P E C T I O N.

Seek in the Tables till against the Distance, taken in its Column, be found the given Departure in one of the following Columns; and adjoining to it stands the Difference of Latitude; which, if greater than the Departure, the Course is found at the Top; but if less, the Course is found at the Bottom.

Now with half the Distance 248, and half the Departure 206, I look in the Tables, and find them to agree in their Columns, nearly over 5 Points, against which is Latitude 137.8 , which being doubled is 275.6, the Difference of Latitude, nearly as before.

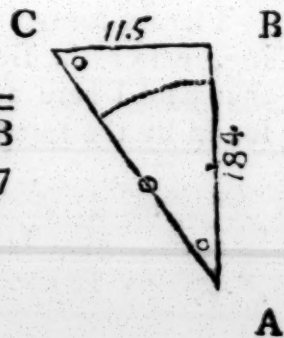
C A S E VI.

Difference of Latitude and Departure given, to find the Course and Distance.

A Ship sails between the North and West till her Difference of Latitude is 184 Miles, and her Departure is 115 Miles, I demand her Course and Distance?

Constructed as Problem IX. in Geometry

Draw $AB=184$, and perpendicular to it $BC=115$; join C and A; then will the Angle CAB be the Course $=32^{\circ}$, and AC the Distance $=217$ Miles.



To find the Course.

As the Diff. of Lat. 184 2.26482
 Is to Radius 10.00000
 So is the Departure 115 2.06070

12.06070
 2.26482

To the Tan. of the Cou. $32^{\circ} 9.79588$

To find the Distance.

As Radius 10.00000
 Is to the Diff. of Lat. 184 2.26482
 So is Sec. of the Cou. $32^{\circ} 10.07158$

12.33640
 10.00000

To the Distance 217 2.33640

Hence her Course is N. 32° Westerly, and Distance sailed 217 Miles.

By G U N T E R.

' Extend from the Difference of Latitude 184 to the Departure 115 on the Line of Numbers, that Extent will reach from Radius or 45° to the Course 32° on the Line of Tangents.'

2dly, ' For the Distance we must consider it as Radius (there being no Line of Secants on the Scale) and extend from Radius or 90° to the Course 32° on the Line of Sines, that Extent will reach from the Departure 115, to the Distance 217 on the Line of Numbers.'

By I N S P E C T I O N.

Seek in the Tables till the given Difference of Latitude 184 and Departure 115 are found together in their respective Columns; then right against them will be found the Distance 217 in its Column, and the Course stands among the Degrees at the Top or Bottom of the Column where the Difference of Latitude and Departure were found, which in this Case is under 32° , the Course required.

The six foregoing Problems are the common Cases of Plane Sailing, which the Learner ought to be well acquainted with; and for that End I here add six more for Practice, whose Answers may be found by the foregoing Rules.

Question I. A Ship in $2^{\circ} 10'$ South Latitude, sails N. by E. 89 Leagues, what Latitude is she in, and what is her Departure?

Answer. Latitude in $2^{\circ} 12' N.$ and Departure 17.36 Leagues.

Question

Question II. A Ship sails S. S. W. from a Port in $41^{\circ} 30'$ North Latitude, and then by Observation the said Ship is in $36^{\circ} 57'$ North Latitude, I demand the Distance run and Departure?

Answer. Distance run 98,5 Leagues, Departure 37,7 Leagues.

Question III. A Ship sails S. S. W. half W. from $2^{\circ} 30'$ South Latitude, until her Departure be 59 Leagues, I demand her Distance run, and Latitude in?

Answer. Distance run 125,2 Leagues, Latitude in $8^{\circ} 1'$ South.

Question IV. If a Ship sails 360 Miles South Westward from $21^{\circ} 59'$ South Latitude, until by Observation she be in $24^{\circ} 49'$ South Latitude, what is her Course and Departure?

Answer. Course is S. W. by W. half W. and Departure from the Meridian is 317.3 Miles.

Question V. Suppose a Ship sails 354 Miles North Eastward from $2^{\circ} 9'$ South Latitude, until her Departure be 150 Miles, what is her Course and Latitude in?

Answer. Course is N. N. E. one quarter E. nearest, and Latitude the Ship is in is $3^{\circ} 12'$ North.

Question VI. Sailing between the North and the West from a Port in $1^{\circ} 59'$ South Latitude, and then arriving at another Port in $4^{\circ} 8'$ North Latitude, which is 209 Miles to the Westward of the first Port, I demand the Course and Distance from the first Port to the second?

Answer. Course is N. N. W. $\frac{3}{4}$ W. and Distance of the Ports is 422.3 Miles, or 140.7 Leagues.

T R A V E R S E S A I L I N G .

HAVING learned these necessary Problems, concerning a Single Course, the next is a Compound Course, commonly called a TRAVERSE; in order to the right understanding of which, observe the following Definitions :

A *Traverse* is when a Ship, meeting with contrary Winds, sails on several Courses.

When the Wind is directly or partly against a Ship's direct Course to the Place she is bound to, she reaches her Port by a Kind of Z like Course; which is made by sailing with the Wind, first on one Side the Ship, and then on the other Side.

In a Ship looking towards the Stem or Head.

Starboard signifies the Right Hand Side.

Larboard the Left Hand Side.

Forwards or *Afore*, is towards the Head or Stem of the Ship.

Aft or *Abaft*, is towards the hinder Part or Stern.

The *Beam* signifies athwart or across the Middle of the Ship.

When a Ship sails the same Way the Wind blows, she is said to sail or run before the Wind; and the Wind is said to be right aft, or right a Stern; and her Course is then 16 Points from the Wind.

When a Ship sails with the Wind blowing directly across her, she is said to have the Wind on the Beam; and her Course is 8 Points from the Wind.

When the Wind blows obliquely across the Ship, the Wind is said to be abaft the Beam, or afore the Beam, according as her Course is more or less than 8 Points from the Wind.

When a Ship endeavours to sail towards that Point of the Compass from whence the Wind blows, she is said to sail on a Wind, or to ply to Windward.

A Vessel sailing as near as she can to the Point from whence the Wind blows, is said to be close hauled. The Generality of Ships will lie within about 6 Points of the Wind, but Sloops and other Vessels will lie much nearer.

The *Windward* or *Weather Side*, is that Side of the Ship on which the Wind blows; and the other Side is called the Leeward or Lee-Side.

Tacks and *Sheets* are large Ropes made fast to the lower Corners of the Fore and Main Sails, by which either of these Corners are hauled fore and aft.

When

When a Ship sails on the Wind, the Windward Tacks are always hauled forwards, and the Leeward Sheets aft.

The Starboard Tacks are aboard when the Starboard Side is to the Windward, and the Larboard to the Leeward; and the Larboard Tacks are aboard when the Larboard Side is to the Windward, and the Starboard to the Leeward.

To know how near the Wind a Ship will lie, Observe the Course she goes on each Tack when she is closed hauled, then Half the Number of Points between the two Courses will shew how near the Wind that Ship will lie.

The most common Cases in turning to the Windward may be constructed by the following Precepts :

Having drawn the Meridian and Parallel of Latitude (or East and West Line) in a Circle representing the Horizon of the Place, mark in the Circumference the Place of the Wind; draw the Rhumb, passing through the Place bound to, and lay thereon the Distance of that Place from the Centre.

On each Side of the Wind lay off in the Circumference the Points or Degrees shewing how near the Wind the Ship can lie, and draw these Rhumbs.

Now the first Course will be on one of these Rhumbs, according to the Tack the Ship leads with; draw a Line through the Place bound to, parallel to the other Point, to meet with the first, and this will shew the Course and Distance on the other Tack.

To RESOLVE a Traverse, is to reduce and bring several Courses into one; the Courses are known by the Compass, and the Distance by the Log, which in common Voyages is heaved once in two Hours, but in Ships of War, or to the East Indies, every Hour.

In the Steerage or some convenient Place in the Ship, there generally hangs a Table, called the Logboard, divided into seven Columns; in the first is written the Hours of the Day, the second the Knots that the Ship runs during Half a Minute, each of these Knots bears the same Proportion to a Sea Mile, that half a Minute does to an Hour; consequently so many Knots as the Ship runs in half a Minute, (the Time allowed for trying the Experiment) so many Miles she runs in an Hour. In the third the Fathoms, 10 of which ought to make a Knot; in the fourth the Courses steered by the Compass; in the fifth the Winds; in the sixth the Leeway, or how far the Ship is drove to the Leeward of the Course steered by the Compass; in the seventh the Transactions of the Day, as in the following Table. Every Day at Noon the Logboard is transcribed into the Logbook, which is divided

64 TRAVERSE SAILING.

vided into Columns, exactly like the Logboard, and the several Courses being corrected for the Leeway and Variation, and the Distance run upon each being set down in a Traverse Table, shews what Difference of Latitude and Departure the Ship has made during the last 24 Hours, and from thence is found the Latitude and Longitude the Ship is in, &c. This Operation is called doing a Day's Work.

The LOG BOARD.

H.	K.	F.	Courses.	Winds.	Lee-way.	Tranfactions.
2	6		S. W. by S.	N.		
4	5	5		N. W.		
6	5					
8	5					
10	4	5	N. E.	N. N. W.		Moderate Gales and fair Weather; at 8 A. M. saw a Ship to the Northward.
12	4	5				
2	4	5				
4	4	5				
6	4	5				
8	5		S. W. by S.	W. N. W.		
10	4	5				
12	4					

Having placed the several Courses and Distances run upon each, begin with the first Course S. W. by S. which is 3 Points, and the Distance run upon it being summed up, is 21.5, or an Half, which being doubled (because the Log is hove every two Hours) is 43. In like Manner proceed with the other Courses, and then find the Difference of Latitude and Departure for each Course and Distance.

When the Course is to the Southward, the Difference of Latitude must be set in the Column marked S. but if to the Northward, in that marked N. likewise when the Course is to the Eastward, the Departure must be set in the Column marked E. but if to the Westward, in that marked W. Thus the first Course being S. W. by S. 3 Points, the Difference of Latitude belonging to it is set under S. and the Departure under W. as in the following Table.

The

The TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. W. by S.	43		35,8		23,9
N. E.	45	31,8		31,8	
S. W. by S.	27		22,4		15,0
		31,8	58,2		38,9
			31,8	31,8	31,8
		D. Lat. S.	26,4	Dep. W.	7,1

Here the Westings being greater than the Eastings, the Difference shews how far the Ship has got to the Westward ; and the Southings being greater than the Northings, shew how far she has got to the Southward of the Place she set out from.

Now the Difference of Lat. 26.4 and Dep. 7.1 being looked for in the Tables, will be found nearly standing together under 15° and against Dist. 27. Hence the Course made good upon the several Courses is S. 15° W. and Dist. 27 Miles.

In heaving the Log, one Man holds the Reel upon which the Log-Line is wound, and another holds the Half-Minute Glass; an Officer of the Watch heaves the Log over the Stern on the Lee-side, and when he observes the stray Line is run off the Reel (to denote which there is fixed a red Rag) he cries *turn!* the Glass-holder answers *done!* who, watching the Glass, the Moment it is run out, cries *stop!* the Reel being immediately stopped, the Knots, or Knots and Fathoms run off, shew the Ship's Rate of Sailing per Hour, if the Wind is constant.

EXAMPLE I.

Yesterday at Noon we were in Lat. $24^{\circ} 32'$ N. and have till this Day at Noon run the following Course and Distances per Log. viz. S. W. by W. 45 Miles, E. S. E. 50 Miles, S. W. 30 Miles, S. E. by E. 60 Miles. Required the Lat. come to, and the direct Course and Distance sailed?

I

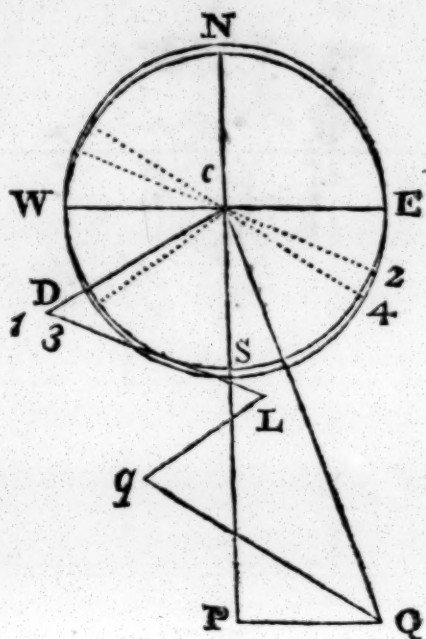
By

By PROJECTION.

With the Chord of 60° describe a Circle to represent the Compass, and through the Centre C draw the Meridian S. N. and the Parallel, or East and West Line W. E.

Take from the Line of Rhumbs on the Plane Scale each Course, and lay it off from the Meridian on the Circumference, marking it with its proper Number, 1, 2, 3, 4, and draw the obscure Lines $c 1, c 2, c 3, c 4$.

The first Course set off is $c 1 = S. W.$ by W. 5 Points, produce $c 1$, if necessary, and lay off on it the first Distance 45 Miles from c to D, then will D represent the Ship's Place at the End of her first Course.



Next draw D L parallel to the E. S. E. Line $c 2$, which make equal to the second Distance 50 Miles—L q parallel to the S. W. Line $c 3 = 30$ Miles, and q Q parallel to the S. E. by E. Line $c 4 = 60$ Miles, then will Q represent the Ship's Place at the End of her several Courses.

Produce the Meridian $c S$ to P, and draw the Line P Q parallel to W. E. and join $c Q$, then will $c P$ be the Difference of Lat. 98,5, P Q the Departure 37,5, $c Q$, the Distance 105,5 Miles, and the Angle P c Q the Course $20^\circ 50'$.

Hence the direct Course made good is S. $20^\circ 50'$, E. and Distance 105,5 Miles.

To Work the same by INSPECTION.

Complete the Traverse Table as before directed, and write down the several Courses and Distances run upon each.

Begin with the first Course S. W. by W. 5 Points, Distance 45 Miles.

Over 5 Points, in the Table of Points, and against Distance 45, stand 25,0 in the Column marked Diff. of Lat. at the Bottom, and 37,4 in the Column marked Departure. And as the Course is between the South and West, set the Difference of Latitude under S. and the Departure under W.

In like Manner proceed with the several Courses and Distances; and when found will stand as in the following Traverse Table.

The

The TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. W. by W.	45		25,0		37,4
E. S. E.	50		19,1	46,2	
S. W.	30		21,2		21,2
S. E. by E.	60		33,3	49,9	
		Diff. of Lat.	98,6	95,1 58,6	58,6
			Dep.	37,5	

Lat. left	—	—	24° 32' N.
Diff. of Lat. 98,6	—	—	1 39 S.
Lat. in	—	—	22 53 N.

Having placed them as above, add up the Westings, Eastings, Southings, and Northings, and set down their respective Sums at the Bottom of each Column, and as the Eastings are greater than the Westings, subtract the less from the greater, and the Difference 37,5 shews how far the Ship has gone to the Eastward of her first Place; and as there are no Northings, the Sum 98,5 in the Column marked S. shews how far she has gone to the Southward of her first Place,

To find the Course and Distance made good.

With the Difference of Latitude 98,6 and Departure 37,5 enter the Tables, and you will find the nearest Numbers to these standing together are 98,1 and 37,6 under 21°, and against Distance 105; hence the direct Course is S. 21° E. and Distance 105 Miles, and Lat. in is 22° 53' N. The same may be found by Calculation.

Calculation for it will be,

To find the Course.

As the Diff. of Lat. 98.6 1.99388
Is to Radius 90° 10.00000
So is the Departure 37.5 1.57403

11.57403
1.99388

To Tan. Course 20° 50' 9.58015

To find the Distance.

As Sine Course 20° 50' 9.55102
Is to Departure 37° 5' 1.57403
So is Radius 90° 10.00000

11.57403
9.55102

To the Distance 105.5 2.02301

Hence the Course is S. 20, 50 E. and Distance 105,5 Miles nearly as before.

E X A M P L E II.

Suppose a Ship from the Lizard in Latitude 49° 57' is bound to Cork in the Latitude 51° 49' N. whose Departure from the Meridian is 162 Miles West, but by Reason of contrary Winds is obliged to sail on the following Courses, viz. S. S. W 54 Miles; W. by S. 39 Miles, N. W. by N. 40 Miles, N. E. by E. 69 Miles, N. N. W. 60 Miles; I demand the direct Course, Distance, Difference of Latitude and Departure made good upon these several Courses, with the Latitude the Ship is in, and what Course she must steer, and how far, to gain her intended Port?

By P R O J E C T I O N:

Latitude of Cork ——— 51° 49'
Latitude of Lizard ——— 49 57

Difference of Latitude 1 52 = 112 Miles, the Dep. 162 M.

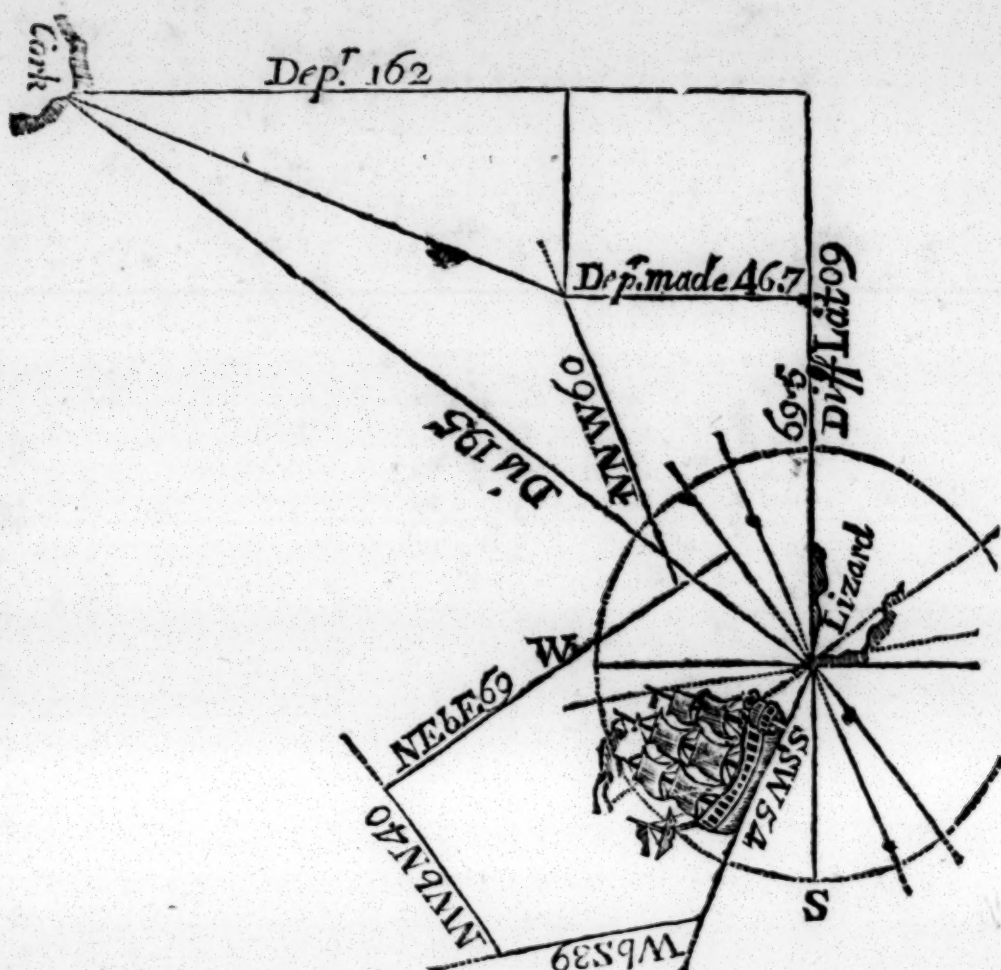
With the Difference of Latitude 112, and the Departure 162, between the Lizard and Cork by the last Case, the Course will be found nearly N. W. by W. and Distance 197 Miles.

With the Chord of 60° describe a Circle, through which draw the Meridian, North and South, and crossing that at Right Angles, draw the East and West Points. The Centre represents the Lizard; then set of two Points from the South Westerly, through which draw

draw a Line to the Centre for the first Course S. S. W. upon that set off the first Distance run 54 Miles, which is the Ship's Place at the End of her first Course; draw the W. by S. Rhumb, and parallel to it, a Line passing through the Ship's last Place, and upon that set off 39 for the second Distance; draw the N. W. by N. Rhumb, and parallel to it, as before, draw a Line passing through the Ship's last Place, upon which set off 40, and that will be the Place of the Ship at the End of her third Course; then draw the N. E. by E. Rhumb, and parallel to it, a Line passing through the Ship's last Place, and upon that set off 69 for the fourth Distance; then draw N. N. W. Rhumb, and parallel to it, draw a Line, as before, through the Ship's last Place; upon that set off the last Distance 60, which is the Place of the Ship at the End of her several Courses; from which draw a Line parallel to the East and West Line, until it cuts the Meridian; for the whole Departure, from that to the Centre being measured on the same Scale, will give her Difference of Latitude made good upon the several Courses; and a Line drawn from the Ship's last Place to her first, will give her Difference of Latitude made good upon the several Courses; and a Line drawn from the Ship's last Place to her first, will give the whole Distance, and the Angle that it makes with the Meridian will be the Ship's Course.

Now to find what Course she must steer, and how far, draw a Line from the Ship's last Place to her intended Port for her Distance; and a Line drawn from the Ship's last Place, parallel to the Meridian for a new Meridian; and the Angle which that makes with the Distance, will be the Course she must steer to the intended Port; which may be easily understood by looking at the following Figure;

By



By the above Method any Traverse may be constructed, as also the Ship's Way pricked off on the Plane Chart.

But it being rather tedious, and not sufficiently accurate, we generally work at Sea

By INSPECTION.

First, to find the Course and Distance between the two Ports.

In the Table it will be found, that the Numbers standing together nearest to 112 the Difference of Latitude, and 162 the Departure, are 161.3 and 113 over 55° , the Distance answering to these is 197, consequently the direct Course is N. 55° W. or nearly N. W. by W. Distance 197 Miles.

2dly. Begin with the first Course S. S. W. 2 Points, under which in the Tables, and opposite to the Distance 54 Miles, stands 49.9 for the Difference of Latitude, and 20.7 for the Departure; and as the Course is between the South and West, I set the Difference of Latitude under the Column marked S. and the Departure under that

that marked West; in like Manner proceed with each Course and Distance, which, being found as above, will stand as in the following Traverse Table:

The TRAVERSE TABLE.

		Differ. of Lat.		Departure.	
Courses.	Dist.	N.	S.	E.	W.
S. S. W.	54		49,9		20,7
W. by S.	39		7,6		38,2
N. W. by N.	40	33,3			22,2
N. E. by E.	69	38,3		57,4	
N. N. W.	60	55,4			23,0
		127,0	57,5	57,4	104,1
		57,5			57,4
Diff. of Lat. Northerly		69,5	Dep. Westerly		46,7

Having placed them as above, add up all the Westings, Eastings, Northings, and Southings separately, and set down their respective Sums at the Bottom of each Column; and as the Westing is greater than the Easting, subtract the one from the other, and the Difference 46,7 shews that the Ship's Departure is so much West of her first Meridian.

Again, the Northing being greater than the Southing, subtract the Lesser from the Greater, and the Remainder 69,5 shews how far the Ship is to the Northward of her first Place.

Now having the Difference of Latitude and Departure made good upon the several Courses, seek in the Tables until they are found standing together in their respective Columns, the nearest to which is 69,6 and 47 under 34 Degrees, against them stands 84 for the Distance; consequently the Course made good upon the several Courses is N. 34 W. Distance 84 Miles.

To find the direct Course and Distance to the intended Port.

To the Latitude left $49^{\circ} 57'$ N. add the Difference 69 equal $1^{\circ} 9'$ gives $51^{\circ} 6'$ the Latitude in: Then

From the Latitude Cork	—	51,49
Subtract the Latitude in	—	51,6

The Diff. of Latitude between the Ship and Cork is 43 Miles

TRAVERSE SAILING.

The Departure between the two Ports is — 162 Ms.
 The Departure made being W. subtract — 46.7

The Departure between the Ship and Cork is — 115.3 Ms.

With this Difference of Latitude 43, and Departure 115.3, seek in the Table till they are found standing together in their respective Columns, the nearest to which will be found over 69° and 70° , being added is 139, half that Sum $69^{\circ} 30'$ is the Course, and half the Distance to these is 123 Miles.

Hence the Ship's direct Course to Cork is N. $69^{\circ} 30'$ W. and Distance 123 Miles.

The same may be done

By CALCULATION.

To find the direct Course and Distance between the Lizard and Cork by Case VI. it will be,

To find the Course.		To find the Distance.	
As the Diff. of Lat. 112	2.04922	As the S. of Cou. $55^{\circ} 20'$	9.91512
Is to Radius	10.00000	Is to the Departure 162	2.21951
So is the Departure 162	12.20951	So is Radius	10.00000
	<u>12.20951</u>		<u>12.20951</u>
	2.04922		9.91512
	<u>10.16029</u>		<u>2.29439</u>
To the Tan. Cou. $55^{\circ} 20'$		To the Distance 197	

Hence the direct Course and Distance between the Lizard and Cork is N. 55.20 W. or N. W. by W. nearly, Distance 197 Miles. Then,

For the first Course S. S. W. 2 Points, Distance 54 Miles.

To find the Dep.		To find the Diff. of Lat.	
As Radius	10.000000	As Radius	10.000000
Is to the Distance 54	1.73239	Is to the Distance 54	1.73239
So is S. Course 2 Pts.	9.58285	So is Co-sine Course, 2 Pts.	9.96562
	<u>11.31524</u>		<u>11.69801</u>
	10.00000		10.00000
To the Departure 20.7	<u>1.31524</u>	To the Diff. of Lat. 49.9	<u>1.69801</u>

In

In like Manner proceed to find the Difference of Latitude and Departure for the other Courses and Distance; which being found and set down in their respective Columns, will stand as in the foregoing Table.

Having found the Difference of Latitude and Departure made upon the several Courses, and also the Latitude in, with the Difference of Latitude and Departure between the Ship and Cork, as before, the direct Course by Case VI. will be found N. $69^{\circ} 33'$ W. and Distance 123 Miles.

All the preceding may be found by Gunter's Scale, but shall leave the working of them to exercise the Learner, who ought to be well acquainted with Traverse Sailing; and for that Purpose it has been thought proper to subjoin the following, which is the most general and useful that well can be, and may be worked by any of the foregoing Methods.

A Ship being at Sea in Latitude $37^{\circ} 10'$ N. is bound to a Port in Latitude $33^{\circ} 0'$ N. the Departure between the Ship and the Place is 180 Miles, consequently by Case VI. the Course will be S. W. by S. 2 Degrees Westerly, and Distance 308 Miles, but the Wind being variable, is obliged to ply upon these several Courses, the Distance run upon each being obtained by the Log; and first she sails (with her Larboard Tacks on Board) S. W. by W. 27 Miles, W. S. W. half W. 30 Miles, W. by S. 25 Miles, W. by N. 18 Miles.

(Starboard Tacks on Board Wind shifting) S. S. E. 32 Miles, S. S. E. three quarters E. 27 Miles, S. by E. 25 Miles, S. 31 Miles, S. S. E. 39 Miles.

Required the Latitude the Ship is in and her Departure from the Meridian, upon what Course she must steer if possible, and how far she must sail to gain her intended Port?

The Difference of Latitude and Departure being found by the preceding Directions, will stand as in the following Table:

The TRAVERSE TABLE.

Courses.	Distances.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
S. W. by W.	27		15,0		22,4
W. S. W. $\frac{1}{2}$ W.	30		8,7		28,7
W. by S.	25		4,9		24,5
W. by N.	13	3,5			17,7
S. S. E.	32		29,6	12,2	
S. S. E. $\frac{1}{4}$ E.	27		23,2	13,9	
S. by E.	25		24,5	4,9	
South.	31		31,0		
S. S. E.	39		36,0	14,9	
		3,5	172,9	45,9	93,3
			3,5		45,9
		Diff. Lat.	169,4 S.	Depar.	47,4 W

The Ship is in Latitude $34^{\circ} 20'$ N. the Departure is 47.4 W.

The Course made good is S. $15^{\circ} 38'$ W. and Distance 175.9.

The Course to the intended Port is S. $58^{\circ} 41'$ W. or S. W. by W, one quarter West nearly, Distance 155.2.

NOTE. The Teacher may put the Pupil upon MERCATOR'S SAILING immediately, if his Time be short (which is the Case with many who go to School purely to learn Navigation only) without going through MIDDLE LATITUDE SAILING, as the former is fully sufficient for the Seaman's Purpose, provided he be shewn how to reduce Miles of Easting or Westing, into Difference of Longitude, which must be done by Middle Latitude Sailing.

MIDDLE

MIDDLE LATITUDE SAILING.

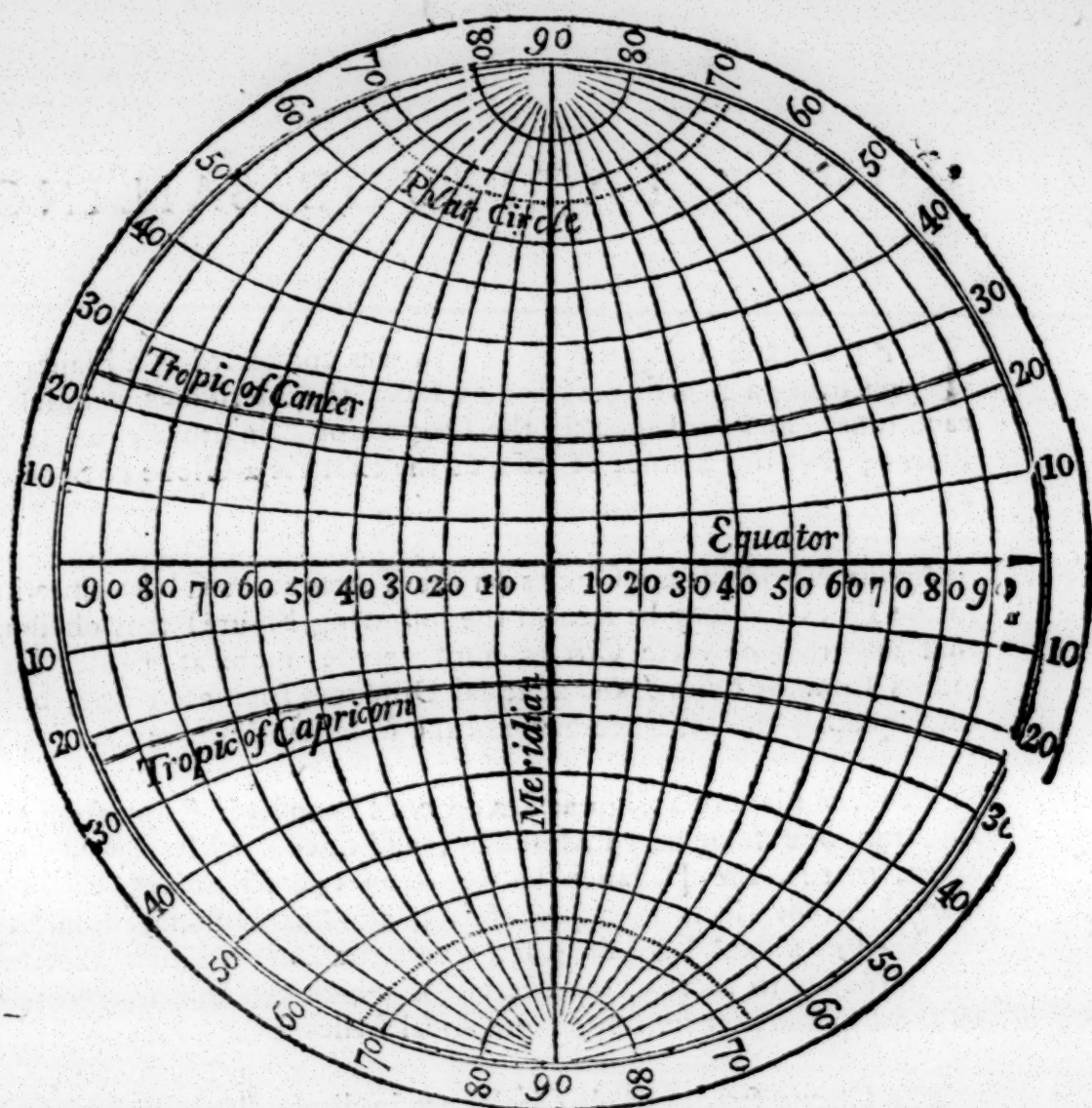
IN PLANE SAILING the Earth was considered as a Plane, representing a Bowling Green, having the Meridians parallel to each other, and consequently the Degrees of Longitude equal in all Places ; but this cannot be true, as the Earth is a Globe or Sphere ; for

As the Meridians are Circles on the Terraqueous Globe, meeting in the Poles (as may be seen in the following Figure) it is obvious, that any two of these Circles must recede more at greater Distances from the Poles ; and at equal Distances from each Pole, or at the Equator, the Distance between the Meridians is greatest.

The true Place of a Ship at Sea depends upon its Distance from the Equator, and some noted Meridian ; and since the Meridional Distance, that is, the Distance between any two Meridians, varies in every Latitude, it is therefore convenient this Distance should be reckoned in a fixed Latitude ; and where the Degrees are of the same Magnitude with those of the Meridian, which can be no where but on the Equator, where 60 Geographical Miles make a Degree.

The Circumference of all Circles are in direct Proportion to each other, as their Radii ; and since the Earth turns once round its Axis in 24 Hours, every Point upon its Surface must describe Circles parallel to the Equator : Hence it follows, that the Circumference of any Parallel of Latitude in Miles, is to the Circumference of the Equator in Miles, as the Co-Sine of that Latitude is to Radius ; and that the Breadth of a Degree in any Parallel of Latitude is to the Breadth of a Degree upon the Equator, as the Sine Complement of that Latitude is to Radius.

By the last Proportion was the following Table calculated, which shews the Breadth of a Degree of Longitude in every Latitude ; and may be made to answer for any Degrees and Minutes by taking proportional Parts:



D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.	D. L.	Miles.
1	59 99	19	56 73	37	47 92	55	34 41	73	17 54
2	59 96	20	56 38	38	47 38	56	33 55	74	16 53
3	59 92	21	56 01	39	46 62	57	32 68	75	15 52
4	59 86	22	55 63	40	45 95	58	31 79	76	14 51
5	59 77	23	55 23	41	45 28	59	30 90	77	13 50
6	59 67	24	54 81	42	44 59	60	30 00	78	12 48
7	59 56	25	54 38	43	43 88	61	29 19	79	11 45
8	59 42	26	53 93	44	43 16	62	28 17	80	10 42
9	59 26	27	53 56	45	42 43	63	27 24	81	9 38
10	59 08	28	52 97	46	41 68	64	26 30	82	8 35
11	58 89	29	52 47	47	40 92	65	25 36	83	7 32
12	58 68	30	51 96	48	40 15	66	24 41	84	6 28
13	58 46	31	51 43	49	39 36	67	23 45	85	5 23
14	58 22	32	50 88	50	38 57	68	22 48	86	4 18
15	57 95	33	50 32	51	37 70	69	20 50	87	3 14
16	57 67	34	49 74	52	36 94	70	21 52	88	2 09
17	57 37	35	49 15	53	36 11	71	19 54	89	1 05
18	57 06	36	48 54	54	35 26	72	18 55		

The above Table shews how many Miles answer to a Degree of Longitude, at every Degree of Latitude.

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Hence it follows that :

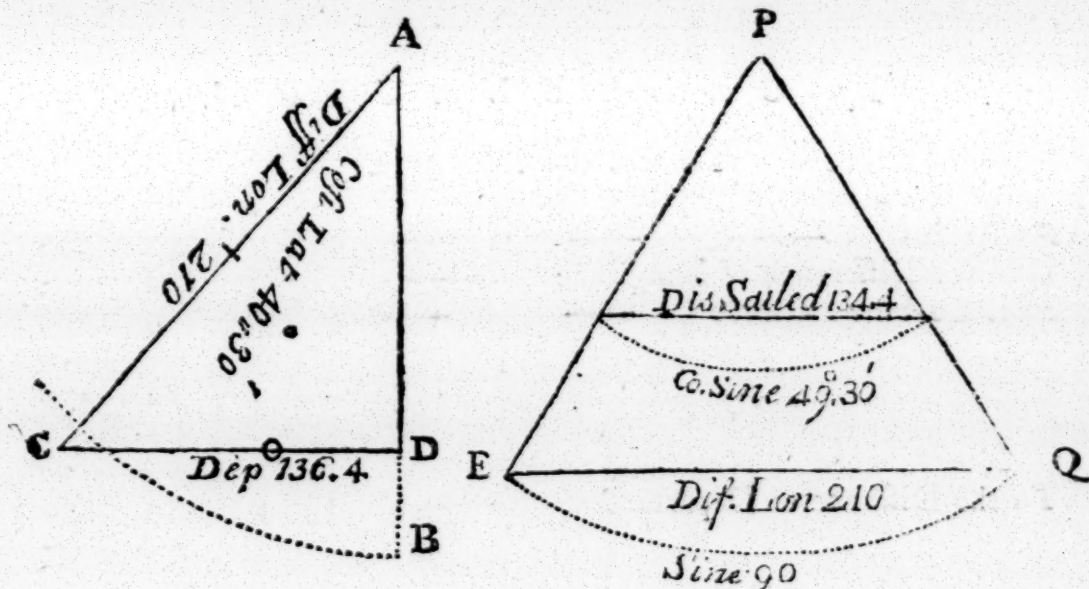
As Co-Sine of any Paral. of Lat.	} >	As Radius, or Sine 90°
Is to the Dist. run in Miles in that		Is to the Diff. of Long. in Miles
Lat.		So is Co-Sine of any Paral. of Lat.
So is the Radius, or Sine of 90°		To the Dist. in Miles between any
To the Diff. of Long. in Miles	} <	Two Merid. in that Paral. of Lat.

From what has been said arises the Solution of the following Problems :

P R O B L E M I.

The Difference of Longitude between two Places both in one Parallel of Latitude being given, to find the Distance between them.

Suppose a Ship in the Latitude 40° 30' N. or S. sails directly E. or W. until her Difference of Longitude be 3° 30', and the Distance sailed be required.



By P R O J E C T I O N.

With the Sine of 90° in your Compasses taken from the Plane Scale, and with one Foot in P describe the Arch EQ, and upon it set off the Difference of Longitude 210 Miles, and draw the Lines PE and PQ to represent the two Meridians ; then will EQ represent the Equator, and P the Pole. Again, with the Sine Com. of the Latitude 49° 30', viz. 40° 30' in your Compasses, taken from the Line of Sines on the Plane Scale, and with one Foot in P. describe an Arch, and the Distance between the Points, where it cuts the two Meridians, being measured upon the same Scale of equal Parts that the Difference of Longitude was, will be the Departure 136.4 Miles.

Or,

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Or, thus :

Draw the Meridian A B, and with the Chord of 60 in your Compasses describe an Arch, and upon it set off the Complement of the Lat. $40^{\circ} 30'$ (taken from the Line of Chords) and set it off upon the Arch as a Course in Plain Sailing, and draw the Line A C as a Distance, which make equal to the Difference of Longitude 210 Miles; then will the Departure C D be the Distance 136.4 Miles, as before; this last Method is preferable to the former, as you are not confined to any particular Scale.

Reverse this Problem, and suppose the Distance sailed in any Parallel of Latitude given, to find the Difference of Longitude.

With the Sine Com. of Latitude in your Compasses describe an Arch, upon which set off the Departure 136.4 Miles, and through the Points where it cuts the Arch draw the Lines P E and P Q; then with the Sine of 90° in the Compasses, and one Foot in the former Centre P, describe an Arch to cut P E and P Q; then E Q being measured upon the small Scale of equal Parts that the Departure was, will be the Difference of Longitude 210 Miles.

By CALCULATION.

To find the Departure.

As Radius	—	—	90°	10.00000
Is to the Difference of Longitude	—	—	210	2.32222
So is Co-Sine Latitude	—	—	$49^{\circ} 30'$	9.81254
				12.13476
				10.00000
To the Distance or Departure	—	—	136.4	2.13476

By GUNTER.

'The Extent from Radius to Sine Com. Lat. $40^{\circ} 30'$ on the Line of Sines, will reach from the Difference of Longitude 210 to the Distance 136.4 on the Line of Numbers.'

By INSPECTION.

Find the Sine Com. of the Latitude among the Degrees, and in the Distance Column the Difference of Longitude; opposite to which, in the Column of Departure, is the Distance required; but as the Co-Latitude is $40^{\circ} 30'$, therefore,

For

MIDDLE LATITUDE SAILING. 79

For 40 Degrees you'll find	135
For 41 Degrees you'll find	137.7
The Sum is	272.7
Half is the Distance required	136.3

This is done because the Table of Difference of Latitude and Departure is calculated only for single Degrees.

By the Reverse of the last Problem, having the Distance run in any Parallel, to find the Difference of Longitude.

Suppose a Ship in Latitude $49^{\circ} 30'$ N. or S. sails directly E. or W. 136.4 Miles, and her Difference of Longitude be required.

As Co-Sine of Latitude	$49^{\circ} 30'$	9.81254
Is to the Distance	136.4	2.13481
So is Radius		10.00000

12.13481
9.81254

To the Difference of Longitude 210

2.32227

By I N S P E C T I O N.

Look for the Complement of the Latitude among the Degrees as if it was a Course, and the Departure in its Column; right against which stands the Difference of Longitude in the Distance Column.

P R O B L E M II.

If it be required to find the Distance of two Places under the same Parallel, and the Distance of two other Places under the same Meridians with the former, differing only in Latitude, it will be,

As the Sine Complement of one Latitude, is to the Distance between two Places in that Latitude, so is the Sine Complement of any other Latitude, to the Distance between two Places in that Latitude, lying under the same Meridians with the former Places.

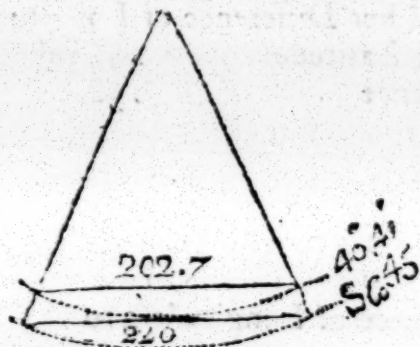
Suppose two Ships in the Latitude 45° N. Distance 220 Miles, sail both directly North 260 Miles, and if it be required to find their Distance asunder,

By

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By P R O J E C T I O N.

Having reduced the Distance sailed 260 Miles into Degrees, and added them to the Latitude sailed from 45° , gives $49^\circ 20'$, the Latitude they are in: with the Sine Complement of the first Latitude 45° in your Compasses describe an Arch; and with the Sine Complement of the second Latitude $40^\circ 40'$ describe an Arch upon the former Centre; then upon the first Arch set off the first Distance, and from the two Extremities draw Lines from the Centre, and they will cut the second Arch in two Points; the Distance between which being measured upon the same Scale, will be 202.7, the Distance the Ships are asunder in the Latitude come to.



By C A L C U L A T I O N.

As the Co-Sine of the Latitude sailed from	45°	9.84948
Is to their Distance asunder	220	2.34242
So is the Co-Sine of the Latitude come to	$49^\circ 20'$	9.31402
		12.15644
		9.84948
To the Distance required	202.7	2.30696

By G U N T E R.

* The Extent from 45° to $40^\circ 40'$ on the Line of Sines, will reach from 220 to 202.7, the second Distance on the Line of Num.*

* From what has been said it will be easy to conceive, that the Longitude counted in one Parallel of Latitude, will not be equal to that counted in any other Parallel of Latitude, on the same Side of the Equator; and as Ships seldom sail N. or S. upon one Meridian, but cross many in various Directions, it follows, that the Longitude can neither be found by the Latitude left, nor by that

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that come to: therefore add them together, and take half that Sum for a Mean or Middle Latitude, by which Departure may be converted into Longitude, and Longitude into Departure; for it will be,

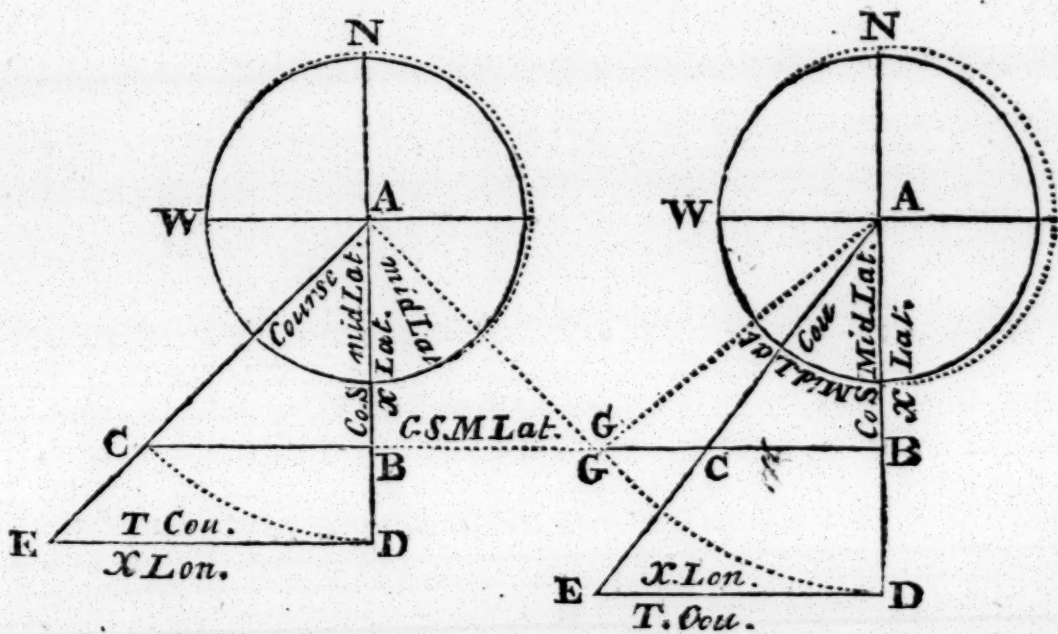
As the Co-Sine of the Mid. Lat.	} ^a { As Radius		
Is to the Dep. from the Merid.		} ^z { Is to the Diff. of Longitude.	
So is Radius			} ^c { So is the Co-Sine of Mid. Lat.
To the Miles of Diff. of Long.			

Or, without having the Departure to find the rest, it will be,

As the Difference of Latitude		As the Co-Sine Middle Lat.
Is to the Difference of Longitude		Is to the Tangent of the Course,
So is the Co-Sine Middle Lat.		So is the Difference of Latitude
To the Tan. of the Course.		To the Difference of Longitude

A N D,

As the Co-Sine Middle Lat.
Is to the Sine Course,
So is the Distance sailed
To the Difference of Longitude.*



* Let $\angle B A G$ be made equal to the Mid. Latitude, $A G (=A D)$ the Radius.

Then $A B$ will be the Co-sine of the Mid. Lat. and $D E$ is the Tang. of the Course of the same Radius $A G$ or $A D$.

But $A B$ is the X of Lat. and $D E$ is the X of Long. by Construction.

Whence $A B$ the X of Lat. : Co-sine Mid. Lat. : : $D E$ Difference of Long. : Tang. Course alternately, as $A B : D E ::$ Co-sine Mid. Lat. : Tang. Course.

I.

CASE

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C A S E I.

The Latitude and Longitude of two Places given, to find the Course and Distance.

Required the Course and Distance from the Lizard to the E. End of the Island of Barbadoes ?

Lizard } Lat. { $49^{\circ} 57' N.$ — $49^{\circ} 57'$ } Long. { $5^{\circ} 14' W.$
E. End Barbadoes } $13 12 N.$ — $13 12$ } $59 37 W.$

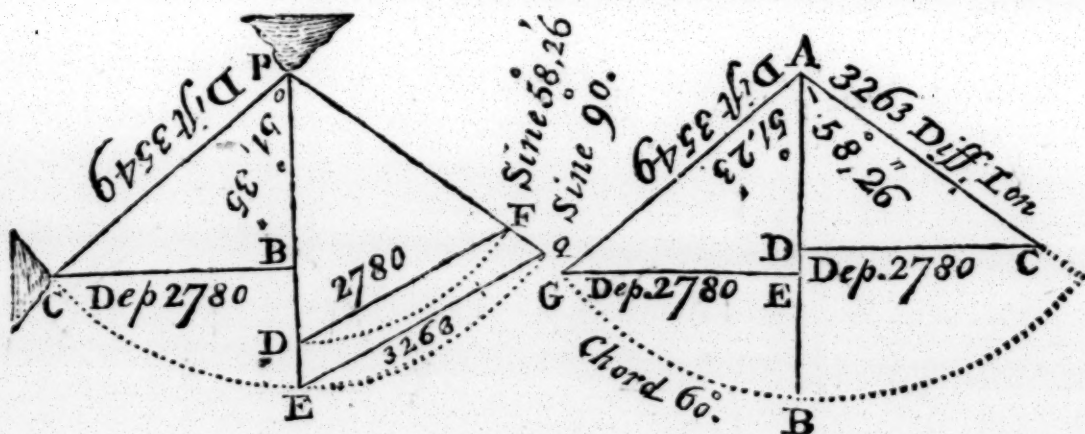
Difference of Latitude $36^{\circ} 45' S.$ Lat. $63 09$ Dif. of Lon. $54 23$
 60

60 Mid. Lat. $31 34$
 $90 00$ in Miles 3263

In Miles

2205

Comp. Mid. Lat. $58^{\circ} 26'$



CONSTRUCTION.

Draw the Line P. E. to represent the Meridian of the Lizard.

Take in your Compasses 90° from the Line of Sines on the Plane Scale and describe the Arch E Q, upon which set off the Dif. of Long. 3263 from E to Q; then will E Q represent the Equator. Draw P Q, then will P E and P Q represent the two Meridians. With the Co-sine of the Middle Latitude $58^{\circ} 26'$ in your Compasses, taken from the Line of Sines, describe the Arch D F

CONSTRUCTION.

Draw the Line A B to represent the Meridian of the Lizard, and with the Chord of 60° describe an Arch, upon which set off the Comp. of Mid. Lat. $58^{\circ} 26'$ as a Course in Plane Sailing, taken from the Line of Chords, and draw the Line A C as a Distance equal to the Dif. of Long. 3263 , from C let fall the Perpendicular C D and that will be the Departure 2780 Miles.

Again set off the Dif. of Lat. 2205 from A to E, upon E erect to

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o cut the Meridians in D and F the Perpendicular E G, which draw the Line D F and that will make equal to the Departure D C be the Departure 2780. 2780, draw the Line G A and it

Set off the Diff. of Lat. 2205 is done, for the Angle G A E will on the Meridian from P to B, on be the Course $51^{\circ} 35'$ and A G the B erect the Perpendicular B C Distance 3549 Miles, the same as which make equal to the Departure before.

ture D F 2780, draw the Line Hence it will be easy to construct any Case in Middle Latitude Sailing by considering the C P and it is done, for the Angle CPB will be the Course $51^{\circ} 35'$ and the Line C P the Distance 3549 which was required. Comp. of Mid. Lat. as a Course in Plane Sailing, and the Diff. of Long. as the Distance, and the Perpendicular let fall on the Meridian will be the Departure.

Then having the Difference of Latitude and the Departure given, the Course and Distance is found the same as in Case the VI. in Plane Sailing.

By the last Method are the following Cases in Middle Latitude Sailing constructed, being in my Opinion preferable to the former, as the Learner is not confined to any particular Scale of equal Parts, and has only to make use of the Line of Chords.

By CALCULATION.

To find the Departure it will be.

As Radius 90° 10.00000
Is to the Diff. Long. 3263 3.51362
So is Co-fi. Mid. Lat. $31^{\circ} 34'$ 9.93046

13.44408
10.00000

To the Departure 2780 13.34408

To find the Course it will be.

As the Diff. of Lat. 2205 3.34341
Is to Radius 90° 10.00000
So is the Departure 2780 3.44404

13.44404
3.34341

To the Tang. of Cou. $51^{\circ} 35'$ 10.10063

To find the Distance it will be.

As Co-sine Course $51^{\circ} 35'$ 9.79335
Is to the Diff. of Lat. 2205 3.34341
So is Radius 90° 10.00000

13.34341
9.79335

To the Distance

3549 3.55006

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Hence the direct Course from the Lizard to the East End of Barbadoes is S. $51^{\circ} 35'$ W. or nearly S. W. by W. half W. Distance 3549 Miles, or 1183 Leagues.

By G U N T E R.

First, Extend from Radius or 90° to the Co-sine Mid. Lat. $58^{\circ} 26'$ on the Line of Sines, that Extent will reach from the Diff. of Long. 3263 to 2780 the Dep. on the Line of Numbers.

Secondly, Extend from the Difference of Latitude 2205 to 2780 on the Line of Numbers, that Extent will reach from Radius, or 45° to Course $51^{\circ} 35'$ on the Line of Tangents.

Thirdly, Extend from Radius or 90° to the Sine Course $51^{\circ} 35'$ on the Line Sines, that Extent will reach from the Departure 2780 to the Distance 3549 on the Line of Numbers.

By I N S P E C T I O N in the Tables of Difference of Latitude and Departure.

RULE. Find the Degrees of the Complement of Middle Latitude in the Tables of Difference of Latitude and Departure, as if it was a Course in Plane Sailing, and the Difference of Longitude in the Distance Column, as a Distance, in the Departure Column corresponding to these will be the Departure; with the Difference of Latitude and this Departure find the Course and Distance as in Case VI. in Plane Sailing.

But when the Difference of Longitude happens to be too large, as in this Case, divide it by any convenient Number, observing to multiply the Departure, when found by the same Number you divided by.

Here the Difference of Longitude 3263 being too large I divide it by 12, which gives 272, and the Complement of Middle Latitude is 58.26 , but since the Tables are only calculated to single Degrees I look for a 12th of the Difference of Longitude, viz. 272 in the Distance Column over 58 and 59 Degrees, and the Departures corresponding to these are 230,7 and 233,1 their Sum is 463,8 half is 231,9, which multiplied by 12 gives 2782 for the Departure.

Now having the Difference of Latitude and Departure the Course and Distance is found, as in Case VI. in Plane Sailing.

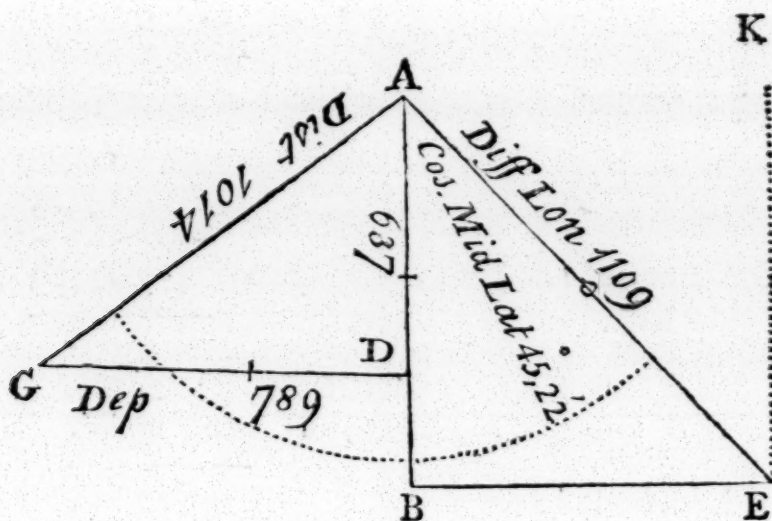
C A S E

C A S E II.

Both Latitudes and the Departure from the Meridian given to find the Course and Distance, and Difference of Longitude.

A Ship in Latitude $49^{\circ} 57' N.$ and Longitude $5^{\circ} 24' W.$ sails South Westerly, till her Departure is 787 Miles, and she be in Latitude $39^{\circ} 20' N.$ I demand the Course, Distance, and Longitude she is in ?

Latitude left	$49^{\circ} 57' N.$	Latitude left	$49^{\circ} 57' N.$
Latitude in	$39^{\circ} 20' N.$	Latitude in	$39^{\circ} 20' N.$
Diff. of Latitude	$\begin{array}{r} 10\ 37 \\ 60 \end{array}$	Sum of Lat.	$\begin{array}{r} 89\ 17 N. \\ \hline \end{array}$
In Miles	$\begin{array}{r} 637 \\ \hline \end{array}$	Middle Lat.	$\begin{array}{r} 44\ 38 \\ 90\ 00 \\ \hline \end{array}$
		Comp. of Mid. Lat.	$\begin{array}{r} 45\ 22 \\ \hline \end{array}$



C O N S T R U C T I O N .

Draw the Meridian A D, from A to D set off the Difference of Latitude 637 Miles, and on D erect the Perpendicular D G, which make equal to the Departure 789 Miles, Draw the Line A G, and that will be the Distance 1014 Miles, and the Angle D A G the Course $51^{\circ} 05'$.

Again, draw E K parallel to A D, making the Distance from A D equal to the Departure D G 789, take the Complement of the

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the Middle Latitude $45^{\circ} 22'$ in your Compasses from the Line of Chords and set that off, on the Arch on the opposite Side of the Meridian A D through where that cuts the Arch, draw the Line A E to cut the Line K E in E, from E let fall the Perpendicular E B and it is done, for A E will be the Difference of Longitude 1109 Miles.

By CALCULATION.

To find the Course it will be. To find the Distance it will be,

As the Diff. of Lat. 637	2.80414	As the Sine Course $51^{\circ} 5'$	9.89101
Is to Radius	90° 10.00000	Is to Departure 789	2.89708
So is Departure	789 2.89708	So is Radius	90° 10.00000
	12.89708		12.89708
	2.80414		9.89101
To Tang. Course $51^{\circ} 05'$	10.09294	To the Distance 1014	3.00607

To find the Difference of Longitude it will be,

As Co-sine Middle Latitude $44^{\circ} 38'$	9.85225
Is to Departure	789 2.89708
So is Radius	90° 10.00000
	12.89708
	9.85225

To Difference of Longitude 1109 3.04483

Longitude the Ship sailed from $5^{\circ} 24' W.$
Diff. Long. 1109 Miles, or $18^{\circ} 29' W.$

Longitude in $23^{\circ} 53' W.$

By GUNTER.

First. The Extent from the Difference of Latitude 637 to the Departure 789, on the Line of Numbers, will reach from Radius, or 45° backward to $51^{\circ} 05'$ the Course on the Line of Tangents.

Secondly. The Extent from $51^{\circ} 5'$ to Radius, or 90° on the Line of Sines will reach from the Departure 789 to the Distance 1014 on the Line of Numbers.

Thirdly.

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Thirdly. The Extent from the Complement of Middle Latitude $45^{\circ} 22'$ to Radius or 90° on the Line of Sines, will reach from the Departure 789 to the Difference of Longitude 1109 on the Line of Numbers.

By I N S P E C T I O N.

RULE. With the Difference of Latitude and Departure find the Course and Distance, as in Case VI. in Plane Sailing.

Secondly, Take the Comp. of Mid. Lat. as a Course and the Departure in its Column and the Distance corresponding to these will be the Difference of Longitude.

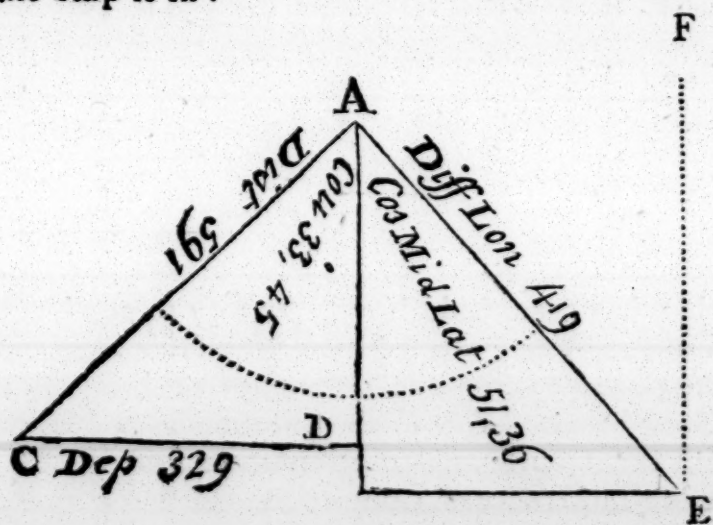
Thus, taking a Tenth of the Difference of Latitude 637 and Departure 789, viz. 63.7 and 78.9 the nearest Numbers to these are 63.6 and 78.5 standing together over 51° and against Distance 101 which multiplied by 10 gives 1010, whence the Course by Inspection is S. 51° W. and the Distance 1010.

Taking $45^{\circ} 22'$ or 45° as a Course, and a Tenth of the Departure 78.9 in its Column the nearest is 78.5 in the Distance Column stands 111 which multiplied by 10 gives 1110 for the Difference of Longitude nearly as before.

C A S E III.

One Latitude, Course, and Distance, given, to find the Difference of Latitude and Difference of Longitude.

A Ship in Latitude $42^{\circ} 30' N.$ and Longitude $18^{\circ} 31' W.$ sails S. E. by S. 591 Miles, or 197 Leagues, I demand the Latitude and Longitude the Ship is in ?



By

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By PROJECTION.

With the Course and Distance find the Difference of Latitude and Departure, as in Case I. in Plane Sailing, viz. Draw the Meridian A D, and on A describe an Arch with the Chord of 60°, and upon it set off the Course, S. E. by S. or 3 Points, through where that cuts the Arch draw the Line A C, making it equal to the Distance 591, from C let fall the Perpendicular C D, then will C D be the Departure and A D the Difference of Latitude 491 Miles.

Draw the Line E F parallel to A D, making the Distance from it equal to the Departure.

Take the Com. of Mid. Lat. 51° 36' from the Line of Chords in your Compasses and set it off on the Arch on the other Side of the Meridian A B and through where that cuts the Arch draw the Line A E to cut the Line E F in E, from E let fall the Perpendicular E D and it is done, for A E will be the Difference of Longitude, 419 Miles.

Lat. left	———	42° 30' N.
Difference of Latitude 491		8 11 S.
		—————
Latitude in		34 19 N.
Latitude left		42 30 N.
		—————
Sum Lat.	2) 76 49	
		—————
Mid. Lat.		38 24
		90 00
		—————
Com. Mid. Lat.		51 36
		—————
Long. left		18 31 W.
Diff. of Long. 419		6 59 E.
		—————
Long. in	———	11 32 W.
		—————

From what has been said, it will be easy to construct any of the following Cases, as they are constructed the same as in Plane Sailing, only observing that to find the Difference of Longitude you must take the Complement of Middle Latitude as a Course in Plane Sailing, with this Course and the Departure find the Distance, and that will be the Difference of Longitude.

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To find the same by CALCULATION.

To find the Difference of Lat.

As Radius 90° 10.00000
Is to the Distance 591 2.77159
So is Co-sine Cou. 3 Pts. 9.91985

12.69144
10.00000

To Diff. of Lat. 491.4 2.69144

To find the Departure.

As Radius 90° 10.00000
Is to Distance 591 2.77159
So is Sine Course 3 Pts. 9.74474

12.51633
10.00000

To the Departure 328.2 2.51633

To find the Difference of Longitude.

As Co-sine Middle Latitude $38^{\circ} 24'$ 9.89415
Is to Departure 328.3 2.51627
So is Radius 90 10.00000

14.51627
9.89415

To Difference of Longitude 419 2.62212

Whence the Ship is in Latitude $34^{\circ} 19'$ N. and Longitude $11^{\circ} 32'$ W.

By G U N T E R.

First, 'The Extent from Radius, or 8 Points to the Complement of the Course, 5 Points on the Line marked S. Rhumbs, will reach from the Distance 591 to 491 the Difference of Latitude on the Line of Numbers.'

Secondly, 'The Extent from Radius or 8 Points to the Course 83 Points on the Line S. Rhumbs, will reach from the Distance 591 to the Departure 328 on the Line of Numbers.'

Thirdly, 'The Extent from the Sine Com. Mid. Lat. $51^{\circ} 36'$ to Radius, or 90° on the Line of Sines, will reach from the Departure 328 to the Difference of Longitude 419 on the Line of Numbers.'

By I N S P E C T I O N.

RULE. With the Course and Distance find the Difference of Latitude and Departure as in Case the first in Plane Sailing.

M

Secondly,

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Secondly, Take the Com. of Mid. Lat. as a Course and the Dep. in its Column, and against it in the Distance Column stands the Difference of Longitude.

Thus, under the Course 3 Points, and against a Tenth of the Distance $591 = 59,1$ stand 49,1 and 32,8, these multiplied by 10 give 491 for the Difference of Latitude, and 328 for the Departure.

Now taking the Com. Mid. Lat. $51^{\circ} 36'$ or 51° as a Course, and a Tenth of the Departure $328 = 32,8$ in its Column (the nearest is 32,6) against which stands 42 in the Distance Column, this multiplied by 10 gives 420 the Difference of Longitude nearly as before.

If the foregoing Directions be well understood, the Learner will not find it difficult to work the following Cases in Middle Latitude Sailing.

C A S E IV.

Course and Difference of Latitude given, to find the Departure, Distance, and Difference of Longitude.

Suppose a Ship sailing from the Lizard, makes when the Variation, Lee-way, &c. are allowed for, her Course S. 39° W. or S. W. by S. half Westerly, and then by Observation is in Latitude $45^{\circ} 31'N$. What is her Distance run, and Longitude in?

Latitude of the Lizard	$49^{\circ} 57'N$	_____	49 57N
Latitude by Observation	$45 31N$	_____	45 31N
Difference of Latitude	$4^{\circ} 26'$		
	60		
In Miles	266		

		Sum of Latitudes	$95 28$
		Middle Latitude	$47 44$

		Com. Mid. Lat.	$42 16$

By C A L C U L A T I O N.

To find the Departure it will be, To find the Distance it will be,

As the Co-fi. Course 39°	9,89050	As the Co-fi. Course 39°	9,89050
Is to the Diff. of Lat. 266	2,42488	Is to Diff. of Lat. 266	2,42488
So is Sine Course 39°	9,79887	So is Radius 90°	10,00000
	_____		_____
	12,22375		12,42488
	9,89050		9,89050
	_____		_____
To the Departure 215,4	2,33325	To the Distance 342,3	2,53438
	_____		_____

To

MIDDLE LATITUDE SAILING. 91

To find the Difference of Longitude, To find the Longitude in,

As Co-fi. of Mid. Lat. $47^{\circ} 44'$	9.82774	Lizard's Longitude	$5^{\circ} 14' W.$
Is to the Departure	215.4	Diff. of L. 320 M. or	$5^{\circ} 20' W.$
So is Radius	$90^{\circ} 10,00000$	Longitude in	<u>$10^{\circ} 34' W.$</u>
	<u>12,33325</u>		
	<u>9.82774</u>		
To the Diff. of Long. 320.3	<u>2,50551</u>		

C A S E V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Suppose a Ship runs 300 Miles N. Westerly from a Port in $37^{\circ} N.$ Latitude, and Longitude $10^{\circ} 25' W.$ until she be in the Latitude $41^{\circ} N.$ what is her Course and Longitude in ?

Latitude left	—	$37^{\circ} 00' N.$	$37^{\circ} 00' N.$
Latitude in	—	$41^{\circ} 00' N.$	$41^{\circ} 00' N.$
Diff. of Lat.	—	<u>4 00</u>	Sum of Latitude <u>78 00</u>
		60	Middle Latitude <u>39 00</u>
In Miles	—	<u>240</u>	<u>90 00</u>
		Comp. Mid. Lat.	<u>51 00</u>

By C A L C U L A T I O N.

To find the Course it will be, To find the Diff. of Lon. it will be,

As the Distance	300	2.47712	As Co-sine Mid. Lat. 39°	9.89050
Is to Radius	90°	10.00000	Is to Tang. Course	36.52° 9.87501
So is Diff. of Lat. 240		<u>2.38021</u>	So is Diff. of Lat. 240	<u>2.38021</u>
		12.38021		<u>12.25522</u>
		<u>2.47712</u>		<u>9.89050</u>
To the Co-sine Cou. $36^{\circ} 52'$		<u>9.90309</u>	To Diff. of Long. 231.6	<u>2.36472</u>

Longitude left	—	$10^{\circ} 25' W.$
Difference of Longitude		<u>3 52 W.</u>
Longitude in		<u>14 17 W</u>

C A S E VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

A Ship sails E. S. E. from a certain Port in Latitude $50^{\circ} 10' S.$ and Longitude $10^{\circ} 16' E.$ until her Departure from the Meridian be 957 Miles; I demand her Distance sailed, and the Latitude and Longitude the Ship is in?

To find the Diff. of Lat. it will be,

As S. Course 6 Pts.	9.96562	Latitude left	$50^{\circ} 10' S.$
Is to the Departure 957	2.98091	Diff. Lat. 396, or	$6 \quad 36 S.$
So is Co-Sine Cou. 6 Pts.	9.58284		
		Latitude in	$56 \quad 46 S.$
	12.56375		
	9.96562		

To the Diff. of Lat. 396.4 2.59813

To find the Distance it will be,

As S. Course 6 Pts.	9.96562	Lat. left	$50^{\circ} 10' S.$
Is to the Departure 957	2.98091	Lat. in	$56 \quad 46 S.$
So is Radius	10.00000		
		2) 106 56 Sum is	
	12.98091		
	9.96552		$53 \quad 28 \text{ Mid. Lat.}$
			$90 \quad 00$
To the Distance 1036	3.01529		$36 \quad 32 \text{ Com. Mid. Lat.}$

To find the Diff. of Lon. it will be,

As Co fi. Mid. Lt. $53^{\circ} 28'$	9.77473	Long. left is	$10^{\circ} 16' E.$
Is to the Depart. 957	2.98091	Diff. Long. 1608, or	$26 \quad 48 E.$
So is Radius	10.00000		
		Long. in	$37 \quad 4 E.$
	12.98091		
	9.77473		

To the M. Dif. of Ln. 1608 3.20618

C A S E VII.

One Latitude, Distance sailed, and Departure from the Meridian given, to find the Course, Difference of Latitude, and Difference of Longitude.

A Ship in Latitude $49^{\circ} 30' N.$ and Longitude $14^{\circ} 40' W.$ sails South Eastward 645 Miles, until her Departure from the Meridian be

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be 500 Miles ; I demand the Course steered, and the Latitude and Longitude the Ship is in ?

To find the Course it will be,		To find the Diff. of Lat. it will be,	
As the Distance 645	2,80956	As Radius	10,00000
Is to Radius	10,00000	Is to the Distance 645	2,80956
So is the Departure 500	2,69897	So is Co-sine Course 50° 50' 9,80043	
	<u>12,69897</u>		<u>12,69999</u>
	2,80956		10,00000
	<u>9,88941</u>		<u>2,60999</u>
To S. Course 50° 50'		To the Diff. of Lat. 407,3	
Lat. left is	49° 30' N.	Lat. left	49 30
Diff. Lat. 407, or	6 47 S.	Lat. in	42 43
	<u>42 43 N.</u>	Sum is	<u>92 13</u>
Lat. in		Middle Latitude	46 6
			<u>90 0</u>
		Com. Mid. Lat.	<u>43 54</u>

To find the Diff. of Lon. it will be,			
As Co-fi. Mid. Lat. 46° 6' 9,84098			
Is to the Departure 500	2,69897		
So is Radius	10,00000	Long. left	14° 40' W.
	<u>12,69897</u>	Diff. Lon. 721, or	12 01 E.
	9,84098	Long. in	<u>2 39 W.</u>
	<u>12,85799</u>		
To the Diff. of Lon. 721,1	2,85799		

To Solve a Traverse in Middle Latitude Sailing.

How to Solve compound Courses, or Traverses on the Principles of Plane Sailing, has already been shewn ; but it is necessary also to shew how the proper Allowances for Longitude are to be introduced into such Accounts, which is easily done, by either of the following Methods :

First. Complete the Traverse Table to each Course and Distance, and find the whole Difference of Latitude, Departure, and Latitude come to.

Secondly, With the whole Difference of Latitude and Departure, find the direct Course and Distance.

Thirdly,

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Thirdly, With the Latitude left and the Latitude arrived at, find the Complement of Middle Latitude; with which and the Departure find the Difference of Longitude.

This Method is generally used in working a Day's Work at Sea; but those that want more Accuracy may work by the following Method, which should always be done in Latitudes exceeding 51° or 52° where the Meridians converge very fast, and the nearer the Poles the greater will be the Error; but the following Method will be exact enough in any Latitude where Navigation is practical.

By the several Differences of Latitude found in the Traverse Tables, find the Latitudes come to, Middle Latitudes, and Complement Middle Latitudes; with each Complement Middle Latitude and corresponding Departure, find the Difference of Longitude to each Course and set them down in the Columns marked East or West, according to the Departure used: Add up both the East and West Columns of Longitude, and the Difference of their Sums will be the whole Difference of Longitude.

Hence the Longitude in, at the End of each Course, may be readily found by adding the Difference to, or subtracting it from the Longitude left, according as the Case requires; as may be seen in the following Traverse:

E X A M P L E.

Suppose a Ship from the Land's End, in Latitude $50^{\circ} 6' N.$ and Longitude $6^{\circ} W.$ is bound to Gibraltar in the Latitude $36^{\circ} 12' N.$ and Longitude $4^{\circ} 53' W.$ but by Reason of contrary Winds is obliged to sail as follows, viz. S. by W. 24 Miles, W. S. W. 32, N. W. $\frac{1}{2} W.$ 41, S. S. E. $\frac{1}{4} E.$ 49, E. N. E. $\frac{3}{4} E.$ 19, W. 21, N. E. $\frac{1}{2} E.$ 36, S. 41, S. S. W. 92, and N. 36; I demand the Latitude and Longitude the Ship is in, and what Course she must steer, and how far, to gain her intended Port?

With the Difference of Latitude and Difference of Longitude between the Land's End and Gibraltar, the direct Course is found by Case I. to be S. $3^{\circ} 21' E.$ or S. $\frac{1}{4} E.$ nearly, and Distance 835 Miles

Now to work the above TRAVERSE.

Find the Difference of Latitude and Departure for each Course and Distance, either by Inspection or otherwise, as taught in Plane Sailing; which set down in the Traverse Table in their proper Columns.

Add

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Add to the Traverse Table 4 Columns, in which write Diff. Long. Long. in. and Lat. in.

Then with the Difference of Latitude and Departure belonging to the first Course, proceed to find the Latitude in, Middle Latitude, Complement Middle Latitude, Difference of Longitude, and Longitude in, as follows.

Lat. Land's End	50° 6'N.	As S. Co. Mid. Lat.	49.54	9.80897
Diff. Lat.	00 23 S.	Is to the Departure	4.7	0.67210
		So is Radius		10.00000
Latitude in	49 43			
Latitude left	50 6			10.67210
				9.80897
The Sum	99 49			
		To the Diff. of Long	7.3	0.86313
Mid. Lat.	49 54			
	90			
Co. Mid. Lat.	40 06			

Now to the Longitude left	6° 0'W.
Add the Diff. of Longitude	0 7 W.
Longitude in	6 7 W.

In like Manner proceed with the other Courses, and when found as above, will stand as in the following Traverse Table.

NOTE. In adding or subtracting the Latitude and Longitude, if the Tenths in the Difference be above 5, call them 1, if not reject them.

The

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The TRAVERSE TABLE.

Courses.	Dist.	Diff. Lat.		Departure.		Diff. Long.		Lat.in.	Lon.in.
		N.	S.	E.	W.	E.	W.		
								50.6 - .23	6.0 + .7
S. by W.	24		23.5		4.7		7.3	49.43 - .12	6.7 + .46
W. S. W.	32		12.2		29.6		45.7	49.31 - .26	6.53 + .49
N. W. $\frac{1}{2}$ W.	41	26.0			31.7		49.	49.57 - .44	7.42 - .32
S. S. E. $\frac{1}{4}$ E.	49		44.3	21.0		32.4		49.13 + .5	7.10 - .28
E. N. E. $\frac{1}{4}$ E.	19	4.6		18.4		28.2		49.18 0.00	6.42 + .32
West.	21				21.		32.2	49.18 + .23	7.14 - .43
N. E. $\frac{1}{2}$ E.	36	22.8		27.8		42.8		49.41 - .41	6.31 0
S.	41		41.0					49.0 - 1.25	6.31 + .53
S. S. W.	92		85.0		35.2		53.0	47.35 + .36	7.24 0.00
N.	36	36.0						48.11	7.24
		89.4	206.0 89.4	67.2	122.2 67.2	1034	187.2 103.4		
		Diff. Lat. 116.6		Dep. 55.		83.8			

Hence it is plain, that the Ship has made of Southings 116,6, or 117 Miles, $= 1^{\circ} 57'$, which being subtracted from the Latitude left $50^{\circ} 6'$, leaves $48^{\circ} 9'$ the Latitude in; and its differing 2 Miles from that in the Table, is owing to the Tenths happening to be taken too large in finding the successive Latitudes.

N. B. The Column of Long. in, may be omitted, for if the whole Difference of Longitude be added to the Longitude left, it will give the Long. in.

The

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The Meridional Distance or Departure is 55 Miles West, and the Difference of Longitude 83.8 or 84 Miles = $1^{\circ} 24'$ West, which being added to the Longitude left $6^{\circ} 0'$, gives $7^{\circ} 24'$ W. the Longitude in, the same as in the Table.

Now to find the direct Course and Distance to the intended Port.
 From the Lat. in $48^{\circ} 9' 48''$ From the Lon. in $7^{\circ} 24' W.$
 Take the Lat. Gibraltar $36 12 36 12$ Take Lon. Gib. $4 53 W.$

	<u>11 57</u>	<u>84 21</u>	Sum is. Diff. of Long. <u>2 31</u>
	60		60
	<u>717</u>	<u>42 10</u>	Mid. Lat. <u>60</u>
Diff. Lat. in Miles			In Miles <u>151 E.</u>

As the Diff. of Lat. 717	2,85552	As Co-sine Course $8^{\circ} 52'$	9.99478
Is to the Diff. of Lon. 151	2.17898	Is to the Diff. of Lat. 717	2,85552
So is S. Co. Mid. Lat. 42.10	9,86993	So is Radius	10.00000
	<u>12,04891</u>		<u>12,85552</u>
	2,85552		9.99478

To the Tang. Course $8^{\circ} 52'$	9.19339	To the Distance 725.7	<u>2.86074</u>
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Hence the direct Course to Gibraltar is S, $8^{\circ} 52'$ E. or S. $\frac{3}{4}$ E. Distance 726 Miles.

Though this Method of finding the Difference of Longitude for each Course and Distance is true, yet on Account of its being tedious, it is never practised at Sea. The Mariner only finds the Difference of Latitude by Inspection for each Course and Distance, as in Plane Sailing; and having the Latitude left, and the Difference of Latitude, and consequently the Latitude in, with the Sine Complement Middle Latitude, and the whole Departure, finds the Difference of Longitude made upon the several Courses, which is of sufficient Exactness for any Day's Run, as may be seen by the following Operation:

Lat. left	$50^{\circ} 6'$	As the Co-sine Mid. Lat.	$49^{\circ} 7'$	9.81592
Lat. in	<u>48 9</u>	Is to the Departure	55	1,74036
		So is Radius		<u>10,00000</u>
Sum is	<u>2)98 15</u>			
Mid. Lat.	<u>49 7</u>			<u>11,74036</u>
				9.81592
		To the Diff. of Long.	84	<u>1,92444</u>

Nearly the same as found by the other Method.

All the above may be wrought by Inspection or by Gunter, but I shall leave it for the Learner's Practice, and proceed to the true Method of Sailing, invented by Mr. Edward Wright, commonly called Mercator's Sailing.

MERCATOR'S SAILING.

PLANE SAILING, as has been before observed, supposes the Earth and Sea to be in the Form of a Bowling-Green, on which the Meridians are parallel, and the Degrees of Latitude and Longitude equal in all Places; but the Earth and Sea include a round Body or Globe, on which the Degrees of Latitude are equal in all Places, and the Degrees of Longitude decrease from the Equator in Proportion to the Sine Complement of the Latitude.

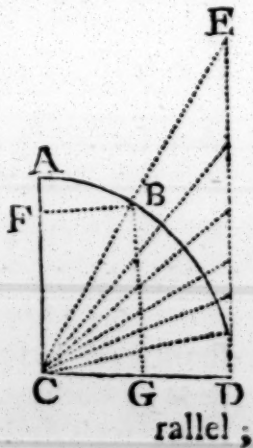
Though the Meridians all meet at the Poles, and the Parallels to the Equator continually decrease, and that in Proportion to the Co Sines of their Latitudes; yet in old Sea Charts the Meridians were drawn parallel to each other, and consequently the Parallels of Latitude made equal to the Equator, and so a Degree of Longitude on any Parallel, as large as a Degree on the Equator: Also in these Charts the Degrees of Latitude were still represented (as they are in themselves) equal to each other, and to those of the Equator; by these Means the Degrees of Longitude being increased beyond their just Proportion, and the more so the nearer they approach the Pole, the Degrees of Latitude at the same Time remaining the same, it is evident Places must be very erroneously marked down upon those Charts, with respect to their Latitude and Longitude, and consequently their Bearing from one another must be very false.

To remedy this Inconvenience, so as still to keep the Meridians parallel, it is plain we must protract or lengthen the Degrees of Latitude in the same Proportion as those of Longitude are, that so the Proportion in Easting or Westing may be the same with that of Northing or Southing; and consequently the Bearing of Places from each other to be the same upon the Chart as upon the Globe itself.

Now to discover how the Meridians are expanded from the Equator in Proportion to the Degrees of Longitude decreasing towards the Poles.

Let A B D in the annexed Scheme, represent the Quarter of the Meridian; F B, the Radius of a Parallel of Latitude; now C G, which is equal to F B is to C D, as a Degree on the Parallel is to a Degree on the Meridian, or any great Circle; and as C G is to C D, so is C B to C E, the Secant of the Latitude of the Parallel.

Therefore in a Projection of the Globe where the Meridians are kept parallel, it is evident, a Degree on the Meridian at any parallel must be equal to the Secant of the Latitude of that Pa-



parallel; and the Distance of any Point, upon the Meridian, from the Equator, is equal to the Sum of the Secants contained between it and the Equator.

Hence it is evident, that by a continual Addition of Secants, beginning at the Equator, a Table of Meridional Parts may be composed for every Degree and Minute in the Quadrant.

Therefore the Meridional Difference of Latitude between any two Places may be easily found, by finding the Meridional Parts answering to both Latitudes, and either adding or subtracting, according as the Case requires; that is, if both North or both South, subtracted; but if one North and the other South, added gives the Meridional Difference of Latitude between them: but the Meridional Difference of Latitude between any Place and the Equator is found, by taking the Meridional Parts belonging to the Latitude of that Place.

To find the Meridional Parts belonging to any Number of Degrees and Minutes of Latitude required.

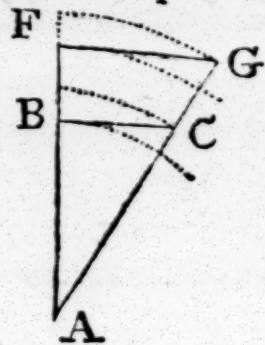
In the Table of Meridional Parts, seek the Degrees on the upper Part of the Table, and in the left or right Hand Column the Minutes marked on the Top with M. opposite to which, and under the Degrees, is the Meridional Parts required.

Suppose the Meridional Parts belonging to $57^{\circ} 18'$ were required?

Look in the Table under 57° , and opposite to 18 stands 4216, the Meridional Parts of $57^{\circ} 18'$.

The same may be observed of any Degrees and Minutes required.

The Solution of the following Problems, as well as all other Trigonometrical Operations in Navigation, depend upon the fourth Proposition of the sixth Book of Euclid; where it is demonstrated, that Triangles which are similar or alike their like Sides are Proportional: Therefore in the annexed Triangles A B C, and A F G, the Radius, Sine, and Sine Complement, or the Radius Tangent, and Secant, form a right angled Triangle; and the Sine Tangent and Secant of any Arch in one Circle, is in Proportion to the Sine Tangent and Secant of the same Arch in another Circle, as the Radius of the one is to the Radius of the other.



Let A B represent the proper Difference of Latitude; B C the Departure; A C the Distance; and the Angle B A C the Ship's Course. Produce A B to F, to represent the Meridional or enlarged Difference of Latitude; and parallel to B C draw F G, to represent the Difference of Longitude. It is plain that A B is in proportion to B C, as A F is to F G; and that the Sine Tangent and Secant of the Triangle F A G, as the Radius A C is to the Radius A G:

N 2

Wherefore,

Wherefore, as the Sine Complement of the Course is to the Meridional Difference of Latitude, so is the Sine of the Course to the Difference of Longitude, and the contrary. And as the proper Difference of Latitude is to the Departure, so is the Meridional Difference of Latitude to the Difference of Longitude.

Hence it will be easy to reduce Departure into Difference of Longitude, and Difference of Longitude into Departure.

Therefore, all Cases in Mercator's Sailing are worked by Geometry, Trigonometry, Gunter's Scale, Inspection, and the Tables exactly the same as in Plane Sailing, by only considering the Meridional Difference of Latitude as proper Difference of Latitude; and the Difference of Longitude as Departure; For it is no more than enlarging the Difference of Latitude that the Difference of Longitude may be in Proportion to the Departure, as the Meridional Difference of Latitude is to the proper Difference of Latitude, the Course continuing the same; and the Sine Complement, or Tangent Complement of the Course bears the same Proportion to the Meridional Difference of Latitude that the Sine or Tangent of the Course does to the Difference of Longitude, and therefore is found in the same Manner as if there were Difference of Latitude and Departure in Plane Sailing.

C A S E I.

The Latitudes and Longitudes of two Places given, to find the direct Course and Distance between them.

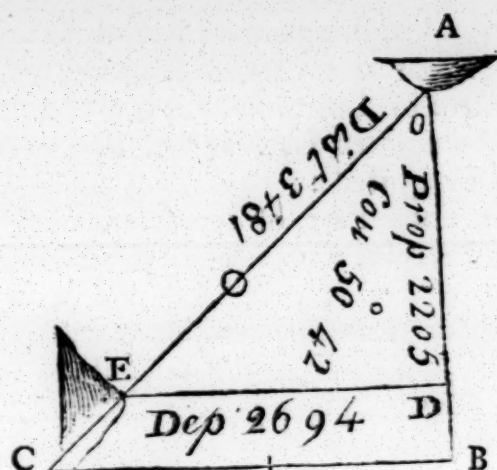
What is the Course and Distance from the Lizard to the East Part of the Island of Barbadoes?

Lat. of the Lizard	49° 57' N.	Mer. Pts.	3470	Long.	5 14' W.
Lat. of Barbadoes	13 12' N.	Mer. Pts.	799	Long.	59 37' W.
	<u>36 45</u>	Mer. Diff.	2671		<u>54 23' W.</u>
	60				60
Prop. Diff. Lat.	<u>2205</u>			Diff. Long.	<u>3263' W.</u>

By C O N S T R U C T I O N.

Draw the Meridian of the Lizard A B, which make equal to the Meridional Difference of Latitude 2671, on B erect the Perpendicular B C, upon which set off the Diff. of Long. 3263, draw the Line C A, then will the Angle B A C be the Course 50° 42'

Secondly



Secondly, Set off the proper Difference of Latitude 2205, from A to D, draw D E parallel to B C, to cut A C in E, then will A E be the Distance 3481 Miles.

To find the same by Calculation.

To find the Course it will be,		To find the Distance.	
As Mer. Diff. of Lat. 2671	3,42667	As Co-sine Course 50 42	9,80166
Is to Radius	90.0 10,00000	Is to P. Diff. of Lat. 2205	3,34341
So is Diff. of Long. 3263	3,51362	So is Radius	90 10,00000
13,51362		13,34341	
3,42667		9,80166	
To the Tan. Cou. 50,42		To the Distance 3481	
10,08695		3,54175	

Whence the direct Course from the Lizard to Barbadoes is S. 50, 42 W. or nearly S. W. by W. $\frac{1}{2}$ W. Distance 3481 Miles.

By G U N T E R.

First, 'The Extent from the Meridional Diff. of Lat. 2671 to the Diff. of Long. 3263 on the Line of Numbers, will reach from Radius, or 45° to $50^{\circ} 42'$ on the Line of Tangents.'

Secondly, 'The Extent from Co-Course $39^{\circ} 18'$ to Radius or 90° on the Line of Sines, will reach from the Proper Diff. of Lat. 2205 to 3481, the Distance on the Line of Numbers.'

By I N S P E C T I O N.

RULE. Look for the Meridional Difference of Latitude and Difference of Longitude, as if they were really Difference of Latitude and

and Departure in Plane Sailing, and the Course will be found among the Points or Degrees at the Top or Bottom; then, instead of the Meridional Difference of Latitude look for the proper Difference of Latitude in Column marked Lat. and in the Column marked Dist. will be the Distance required :

Thus, with the 20th Part of the Mer. Diff. of Lat. 2671 and Diff. of Long. 3263, viz. 133. and 163.1 the nearest Numbers are 163.1 and 133.8 standing over $4\frac{1}{2}$ Pts. which is the Course, over which, in the Lat. Column look for the 20th Part of the proper Diff. of Lat. 2205, viz. 110.2 the nearest is 110.3 against Dist. 174, this multiplied by 20 gives 3480 for the Distance nearly as before.

C A S E II.

Both Latitudes and Course given, to find the Distance and Difference of Longitude.

A Ship sails from the Lizard, and makes her Course S. 39° W. or S. W. by S. half W. and then by Observation is in Latitude $45^{\circ} 31' N$. I demand the Distance run and Longitude she is in ?

Lat. of the Lizard	$49^{\circ} 57' N$.	Meridian Parts	3470
Lat. by Observation	$45^{\circ} 31' N$.	Meridian Parts	3074

4 26	Mer. Diff. Lat.	396
60		

Proper Diff. of Lat. 266



By P R O J E C T I O N.

Draw a Meridian, the lower End of which will represent the Ship's Place in her first Latitude.

Take the proper Difference of Latitude 266 in your Compasses, and with one Foot in the Ship's Place, lay the other upon the Meridian, then take the Meridian Difference of Latitude 396 in your Compasses, and with one Foot in the Ship's Place, as before, lay the other upon the Meridian, and upon these two Points raise Perpendiculars, then a Line drawn from the Ship's Place, making an Angle with the Meridian equal to 39° the Ship's Course, will cut the two Perpendiculars; the first will be the Departure, which terminates the Distance 342, and the other will be the Difference of Longitude 321 Miles.

- From

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From what has been said, it is plain, that any Case in Mercator's Sailing may be projected as a Right-angled Triangle, by only considering the Difference of Longitude or Departure, as the Base; the Meridian, or proper Difference of Latitude, as the Perpendicular; the Hypothenuſe cut by the Departure as Distance; and the Angle which that makes with the Perpendicular, the Course; for in all Cases in Mercator's Sailing, the Meridian Difference of Latitude bears the ſame Proportion to the Difference of Longitude, that the proper Difference of Latitude does to the Departure.

Theſe Inſtructions being well underſtood, will be ſufficient to inform the Learner how to conſtruct any of the following Caſes :

By CALCULATION.

To find the Distance.

As the Co-ſine Courſe 39° 9,89050
Is to the Diff. of Lat. 266 2,42488
So is Radius 10,00000

12,42488
9,89050

To the Distance 342,3 2,53438

To find the Diff. of Lon.

As the Co-ſine Cou. 39° 9,89050
Is to Mer. Diff. of Lat. 396 2,59770
So is S. Courſe 39° 9,79887

12,39657
9,89050

To the Diff. of Lon. 320,7 2,50607

Longitude left	—	5° 14' W.
Difference of Longitude 321, or		<u>5 21</u>
Longitude in	—	<u>10 35 W.</u>

By GUNTER.

' The Extent from 51° to Radius on the Line of Sines, will reach from the proper Difference of Latitude 266, to the Distance 342.3 on the Line of Numbers.'

Secondly. ' The Extent from 51° to 39° on the Line of Sines, will reach from the Meridian Difference of Latitude 396, to the Difference of Longitude 321, on the Line of Numbers.'

By INSPECTION.

Under the Courſe 39° , and againſt half the Difference of Latitude 133, ſtands 171 in the Distance Column, which being doubled is 342,

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342, the Distance; under the same Degrees and in the Latitude Column, look for half the Meridian Difference of Latitude 198, against that in the Departure Column stands 160,5 doubled is 321, the Difference of Longitude.

C A S E III.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

If a Ship runs 300 Miles N. Westward from a Port in Latitude 37° N. and Longitude $10^{\circ} 25'$ W. until she be in Latitude 41° N. I demand the Course steered, and Longitude she is in ?

Latitude left	37° N.	Merid. Parts.	{ 2393
Latitude in	41° N.		{ 2702
	<u>4</u>	Mer. Diff. of Lat.	<u>309</u>
	60		
Pro. Diff. of Lat.	<u>240</u>		



To find the Course.

As the Distance 300	2,47712
Is to Radius	10,00000
So is prop. Diff. Lat. 240.	2,38021
	<u>12,38021</u>
	<u>2,47712</u>

To find the Diff. of Long.

As Co-sine Cou. $36^{\circ} 52'$	9,90311
Is to Mer. Diff. of Lat. 309	2,48996
So is S. Course $36^{\circ} 52'$	9,77812
	<u>12,26808</u>
	<u>9,90311</u>

To Co-sine Cou, $36^{\circ} 52'$	9,90309
To Miles Diff. Lon.	231,7
	<u>2,36497</u>

Longitude left	—	$10^{\circ} 25'$ W.
Difference of Longitude 231, or		<u>3 51</u> W.
Longitude in	—	<u>14 16</u>

By G U N T E R.

' The Extent from the Distance 300, to the proper Difference of Latitude 240, on the Line of Numbers, will reach from Radius to $53^{\circ} 8'$ on the Line of Sines.'

Secondly

Secondly, 'The Extent from $53^{\circ} 8'$ to $36^{\circ} 52'$ on the Line of Sines will reach from the Meridian Difference of Latitude 309, to the Difference of Longitude 231.7, on the Line of Numbers.'

By INSPECTION.

With the Distance and Difference of Latitude find the Course; then in the Latitude Column belonging to this Course, find the Meridian Difference of Latitude; against which, in the Departure Column, stands the Difference of Longitude.

Thus half the Distance 150, and half the Difference of Latitude 120, will be found standing together in their Columns, nearly under 37° , the Course; and in the Latitude Column, find half the Meridian Difference of Latitude 154.5, the nearest to it is 154 1; against which in the Departure Column, is 116.1, which doubled is 232.2, the Difference of Longitude nearly as before.

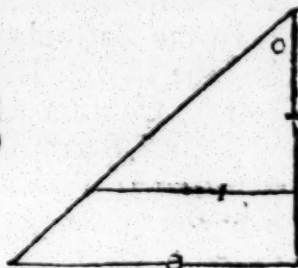
CASE IV.

Both Latitudes and Departure from the Meridian given, to find the Course, Distance, and Difference of Longitude.

A Ship in Latitude $49^{\circ} 57' N.$ and Longitude $5^{\circ} 14' W.$ sails S. Westward till her Departure from the Meridian is 789 Miles, and by Observation is in Latitude $39^{\circ} 20' N.$ I demand her Course steered, Distance sailed, and what Longitude she is in?

Latitude left	$49^{\circ} 57' N.$	Mer. Parts	3470
Lat. by Obs.	$39^{\circ} 20' N.$		2571
	10 37	Mer. Diff.	899
	60		

Proper Diff. Lat. 637



To find the Course,

To find the Distance.

As the Diff. of Lat. 637	2,80414	As the S. Course $51^{\circ} 5'$	9,89101
Is to Radius	10,00000	Is to the Departure 789	2,89708
So is the Departure 789	2,89708	So is Radius	10,00000
	12,89708		12,89708
	2,80414		9,89101
To Tang. Course $51^{\circ} 5'$	10,09294	To the Distance 1014	3,00607

O

To

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To find the Diff. of Long. it will be,

As Co-sine Course	$51^{\circ} 5'$	9,79809		
Is to the M. Diff. of Lat.	899	2,95376	Long. left	$5^{\circ} 14'$
So is S. Course	$51^{\circ} 5'$	9,89101	Diff. of Lon.	1114, or 18 34
		12,84477	Long. in West	23 48
		9,79809		

To the Diff. of Long. 1114 3,04668

By G U N T E R .

' The Extent from the Difference of Latitude 637, to the Departure 789, on the Line of Numbers, will reach from Radius to $51^{\circ} 5'$, on the Line of Tangents.'

Secondly, ' The Extent from $51^{\circ} 5'$ to Radius on the Line of Sines will reach from the Departure 789, to the Distance 1014, on the Line of Numbers.'

Thirdly, ' The Extent from $38^{\circ} 55'$ to $51^{\circ} 5'$ on the Line of Sines, will reach from the Merid. Difference of Latitude 899, to the Difference of Longitude 1114, on the Line of Numbers.'

By I N S P E C T I O N .

The Difference of Latitude and Departure being found together, will give the Course among the Degrees, and the Distance in its Column.

In the Latitude Column belonging to the Degrees of the Course, find the Merid. Difference of Latitude ; opposite to that in the Departure Column will be the Difference of Longitude.

Now a Sixth of the Difference of Latitude 637, and of the Departure 789, are 106.1, and 131.5 ; the nearest to these are found over the Course 51° , and the Distance 169, being multiplied by 6, is 1014, the same as before.

In the Latitude Column over the same Degrees, look for a Sixth of the Merid. Difference of Latitude $899 = 149,8$; against that in the Departure Column stands 185, which multiplied by 6, is 1110 for the Difference of Longitude.

C A 8 E

C A S E V.

One Latitude, Course, and Distance given, to find the Difference of Latitude, and Difference of Longitude.

A Ship in Latitude $42^{\circ} 30' N.$ and Longitude $18^{\circ} 31' W.$ sails S. W. by S. 591 Miles. I demand the Latitude and Longitude the Ship is in?

To find the Diff. of Lat. it will be,

As Radius	10,00000	Lat. left	$42^{\circ} 30'$	M. Part.	{ 2822
Is to the Distance 591	2,77159	Di. Lat. 491	S 11		{ 2194
So is Co-sine Course 3 Pts.	9,91985				
		Latitude in	34 19	M. Diff. Lat.	628
	12,69144				
	10,00000				

To the Diff. of Lat. 491,4 2,69144

To find the Diff. of Lon. it will be,

As the Co-sine Course 3 Pts.	9,991985	Long. left	$18^{\circ} 31' W.$
Is to the Mer. Diff. of Lat. 628	2,79796	Diff. Long. 420, or	7 0 W.
So is S. Course	3 Pts. 9,74474		
		Long. in	25 31 W.
	12,54270		
	9,91985		

To the Miles Diff. Long. 419,6 2,62285

By G U N T E R.

' The Extent from Radius to 5 Points on the Line marked S. R. will reach from the Distance 591, to the Difference of Latitude 491.4 on the Line of Numbers.'

Secondly. ' The Extent from 5 Pts. to 3 Pts. on the Line marked S. R. will reach from the Merid. Difference of Latitude 628, to the Difference of Longitude 419,6, on the Line of Numbers.'

By I N S P E C T I O N .

Under the Courfe 3 Pts. and oppofite a 10th of the Distance 59.1, in the Latitude Column ftands 49.1, which multiplied by 10, is 491, the Difference of Latitude; then find $\frac{1}{4}$ of the Meridian Difference of Latitude 157, in the Latitude Column; againft which ftands 105 in the Departure Column, which multiplied by 4, gives 420, the Difference of Longitude.

C A S E V I .

One Latitude, Courfe, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

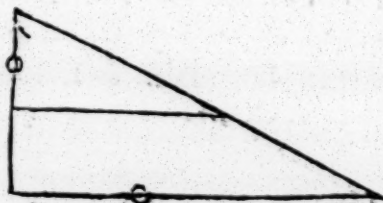
A Ship fails E. S. E. from a certain Port in Latitude $50^{\circ} 10' S.$ and Longitude $10^{\circ} 16' E.$ until her Departure from the Meridian be 957 Miles. I demand the Distance failed, and the Latitude and Longitude ſhe is in ?

To find the Distance it will be,

As the S. Courfe	6 Pts.	9,96562
Is to the Departure	957	2,98091
So is Radius		10,00000

12,98091
9,96562
3,01529

To the Distance	1036	3,01529
-----------------	------	---------



To find the Diff. of Lat. it will be,

As the S. Cou. 6 Pts.	9,96562	Lat. left	$50^{\circ} 10' S.$	Mer. Parts	{ 3499 4157
Is to the Dep. 957	2,98091	Dif. Lt.	396, or 6 36 S.		
So is S. Co. Cou. 6 Pts.	9,58284				

12,56375
9,96562
2,59813

Lat. in	56 46 S.	Mer. Diff.	Lat. 667
---------	----------	------------	----------

To Diff. Lat.	596,4	2,59813
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To

To find the Diff. of Lon. it will be,

As S. Com. Course 6 Pts.	9,58284		
To Mer. Dif. of Lat. 667	2,82413	Long. left	10° 16' E.
So is the S. Course 6 Pts.	9,6562	Diff. Long. 1610, or 26	50 E.
	12,78975	Long. in	37 6 E.
	9,58284		

To the Diff. of Lon. 1610 3,20691

By G U N T E R.

' The Extent from 6 Pts. to Radius on the Line marked S. R. will reach from the Departure 957, to the Distance 1036, on the Line of Numbers.'

Secondly. ' The Extent from 6 Pts. to 2 Pts. on the Line marked S. R. will reach from the Departure 957, to the Difference of Latitude 396.4, on the Line of Numbers'

Thirdly. ' The Extent from 6 Pts. to 2 Pts. on the Line marked S. R. will reach from the Meridian Difference of Latitude 667, to the Difference of Longitude 1610, on the Line of Numbers.'

By I N S P E C T I O N.

Over the Course 6 Pts. and against a 5th of the Departure 191.4, stands 79.2 and 207, which multiplied by 5, gives 396, the Difference of Latitude, and 1035 for the Distance.

Then in the Latitude Column find a 10th of the Meridian Difference of Latitude 66.7 the nearest to that is 66.6; against which, in the Departure Column stands 160.8, which multiplied by 10, is 1608, the Difference of Longitude.

C A S E VII.

One Latitude, Distance sailed, and the Departure from the Meridian given, to find the Course, Difference of Latitude and Difference of Longitude.

A Ship in Latitude 49° 30' N. and Longitude 14° 40' W. sails S. Eastward 645 Miles, until the Departure from the Meridian be 500 Miles. I demand the Course steered, and the Latitude and Longitude she is in?

To

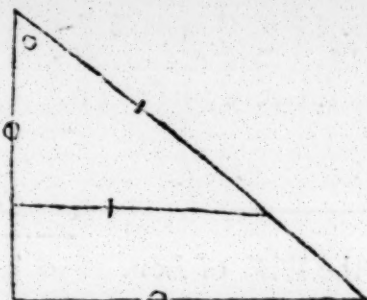
MERCATOR'S SAILING.

To find the Course it will be,

As the Distance 645 2,80956
Is to Radius 10,00000
So is the Departure 500 2,69897

12,69897
2,80956

To S. Course $50^{\circ} 50'$ 9,88941



Hence the Course is S. $50^{\circ} 50'$ E. or S. E. half E. nearly.

To find the Difference of Latitude it will be,

As the S. Cou. $50^{\circ} 50'$ 9,88948
Is to the Departure 500 2,69897
So is Co-sine Cou. $50^{\circ} 50'$ 9,80004

12,49940
9,88948

To Diff. of Lat. 407,3 2 60992

Lat. left is $49^{\circ} 30' \text{N.}$ Mer. Parts. { 3428
Diff. Lat. 407, or $6 \quad 47 \text{ S.}$

Lat. in $42 \quad 43 \text{ N.}$ Mer. Parts. { 2840

Mer. Diff. of Lat. 588

To find the Difference of Longitude it will be,

As Co-sine Course $50^{\circ} 50'$ 9,80043
Is to Mer. Diff. of Lat. 588 2,76938 Long. left $14^{\circ} 40' \text{W.}$
So is Sine Course $50^{\circ} 50'$ 9,88948 Diff. Long. 722, or $12 \quad 02 \text{ E.}$

12,65886 Long. in $2 \quad 38 \text{W.}$
9,80043

To Diff. of Long. 721.8 2,85843

By G U N T E R.

' The Extent from the Distance 645, to the Departure 500 on the Line of Numbers, will reach from Radius to $50^{\circ} 50'$ on the Line of Sines.'

Secondly,

Secondly, 'The Extent from $50^{\circ} 50'$ to $39^{\circ} 10'$ on the Line of Sines will reach from the Departure 500, to the Difference of Latitude 407, on the Line of Numbers.'

Thirdly, 'The Extent from $50^{\circ} 50'$ to $39^{\circ} 10'$ on the Line of Sines, will reach from the Meridian Difference of Latitude 588, to the Difference of Longitude 722, on the Line of Numbers.'

By I N S P E C T I O N.

Now a Fifth of the Distance and Departure are 120 and 100, and are found together over 51° ; and in the Latitude Column stands 81.2, which multiplied by 5, is 406, the Difference of Latitude.

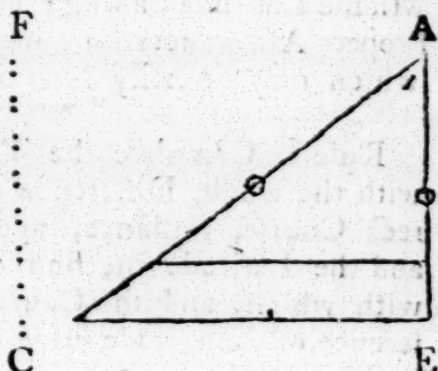
Then in the Latitude Column seek $\frac{1}{4}$ of the Meridional Difference of Latitude 147, the nearest is 146.6; against which, in the Departure Column, stands 181.1, multiplied by four, is 724.4, the Difference of Longitude.

C A S E VIII.

One Latitude, Course, and Difference of Longitude given, to find the Distance, and Difference of Latitude.

If a Ship sails S. W. by W. from the Lizard, until she be in Longitude $57^{\circ} 26' W$. I demand the Latitude the Ship is in, and Distance sailed?

Longitude sailed from	$5^{\circ} 14' W$.	:
Longitude the Ship is in	$57 \quad 26$	:
		:
	52 12	:
	60	:
		:
Diff. of Long. in Miles	3132	:
		:



Draw A E to represent the Lizard, at A make an Angle equal to the Course of 5 Points; then draw F C parallel to A E, at the Distance of 3132 Miles, the Difference of Longitude, which will meet C F in C; let fall the Perpendicular C E, then A E will be the Meridional Difference of Latitude 2093, and $3470 - 2093 = 1377$, the Meridional Parts of the Latitude come to, which in the Tables gives $22^{\circ} 22'$ the Latitude come to; then set off the proper Difference of Latitude 1655 from A towards E, at the End of which draw a Line parallel to the Difference of Longitude, and that will be the Departure, and where it cuts the Line A C, to A, being measured, will be the Distance = 2979 Miles; to find which by Calculation.

As S. Course 5 Pts.	9.91985	Lat. Lizard $49^{\circ} 57'$	Mer. Parts	3470
Is to the Diff. of Lon. 3132	3,49582	Lat. come to 22 22	Mer. Diff.	2093
So is Co-Sine Cou. 5 Pts.	9.74474	Diff. Lat.	27 35	
			60	Mer. Parts }
	13,24056			L. come to }
	9,91985	Diff. in Mil.	1655	1377
To Mer. Diff. of Lat. 2093	3,32071			

As Co-sine Course 5 Pts.	9,74474	
Is to the Diff. of Lat. 1655	3,21886	1377 being looked for in
So is Radius	10,00000	the Table of Meridional
		Parts, will be found stand-
	13,21886	ing under 22° , and opposite
	9,74474	to $22'$, hence the Latitude
		come to is $22^{\circ} 22'$ North.
To the Distance 2979	M. 3,47412	

From what has been said, it will be easy to solve a Traverse according to the Rules of Mercator's Sailing.

How to solve a Traverse has been already shewn both in Plane and Middle Latitude Sailing; we shall now proceed to shew how to make Proper Allowances for Longitude, according to Mercator's Sailing, which may be easily done by any of the following Methods:

Rule I. Complete the Traverse Table as in Plane Sailing, and with the whole Difference of Latitude and Departure, find the direct Course, Distance, and Latitude in; with the Latitude left, and the Latitude in, find the Meridional Difference of Latitude, with which, and the Course (found as above) find the whole Difference of Longitude made upon the several Courses.

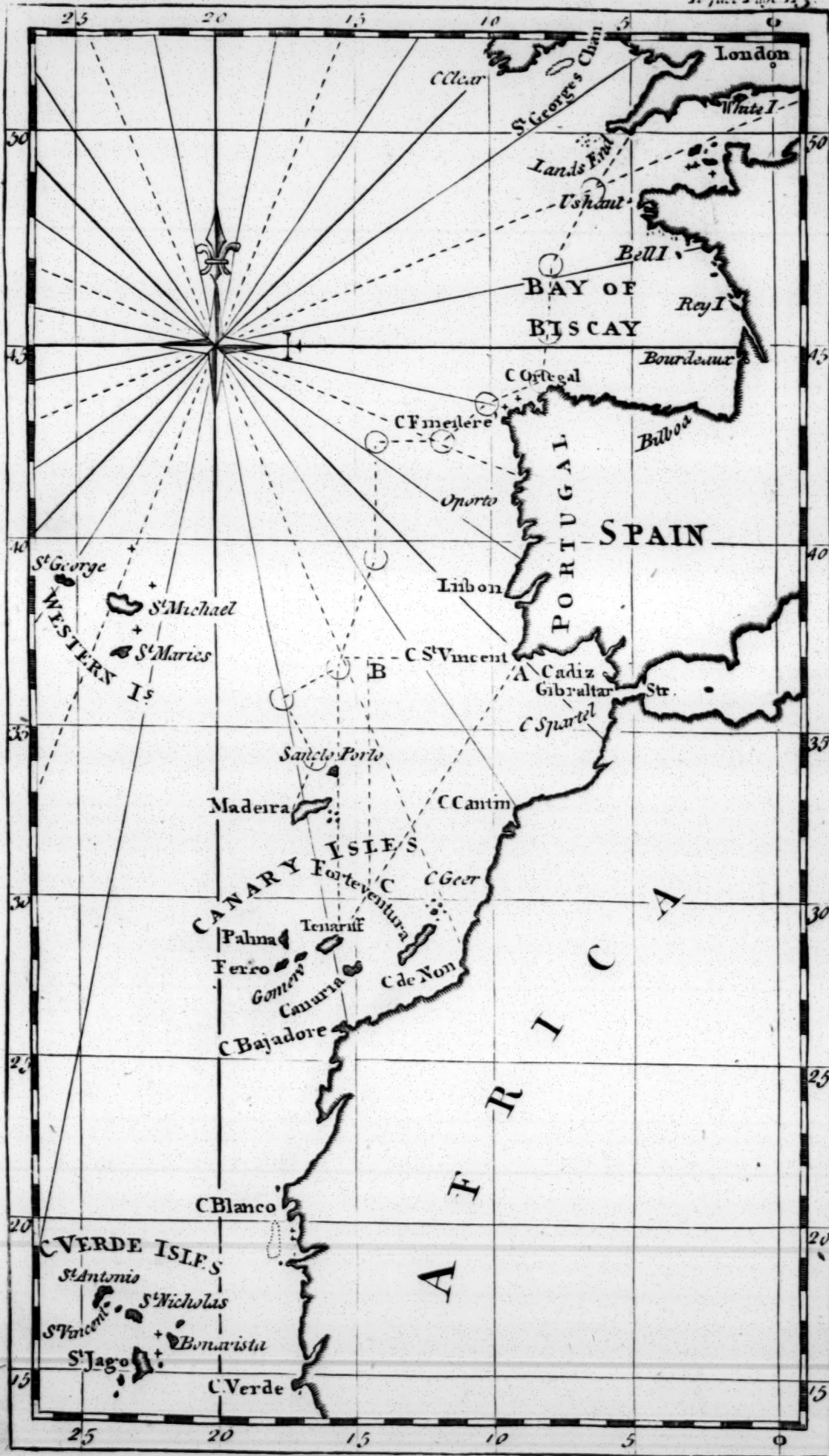
This Method is in common practised at Sea, but those that want a greater Degree of Accuracy, may use the following, which should always be done in Latitudes higher than 51 or 52 , as has been observed in Middle Latitude Sailing.

Rule II. To the Traverse Table annex four Columns, in which write Latitude in, Difference of Longitude, and Longitude in.

With the Latitude left, and Difference of Latitude, find the Latitude in Meridional Difference of Latitude for each Course.

To each Course, and its corresponding Meridional Difference of Latitude, find the Difference of Longitude, which set down in its proper Column.

The



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The Difference of the Sums of the East and West Columns of Longitude will give the Difference of Longitude; or with the Difference of Longitude find the Longitude in at the End of each Course.

These Methods will be exemplified in the following Traverse, which is the same that was taken in Middle Latitude Sailing, that the Learner may see the Difference between Middle Latitude Sailing and Mercator's Sailing.

E X A M P L E

Suppose a Ship from the Land's End, in Latitude $50^{\circ} 6' N.$ and Longitude $6^{\circ} 0' W.$ is bound to Gibraltar, in Latitude $36^{\circ} 12'$, and Longitude $4^{\circ} 53' W.$ but by Reason of contrary Winds is obliged to sail as follows; viz. S. by W. 24 Miles, W. S. W. 32, N. W. $\frac{1}{2}$ W. 41, S. S. E. $\frac{1}{4}$ E. 49, E. N. E. $\frac{3}{4}$ E. 19, W. 21, N. E. $\frac{1}{2}$ E. 36, S. 41, S. S. W. 92, N. 36. I demand the Latitude and Longitude the Ship is in, and what Course she must steer, and how far to gain her intended Port?

With the proper Difference of Latitude 834, Meridional Difference of Latitude 1151, and Difference of Longitude 67, the Course between the Land's End and Gibraltar, is found to be S. $3^{\circ} 20'$ Easterly, or S. $\frac{1}{4}$ E. nearly, and Distance 835 Miles.

Then with the Difference of Latitude and Departure belonging to the first Course, find the Latitude in, Meridional Difference of Latitude, Difference of Longitude, and Longitude in.

Latitude left	—	$50^{\circ} 6' N.$	Merid. Parts.	{ 3484
Difference of Latitude		23 S.		{ 3448
Latitude in	—	<u>49 43 N.</u>	Mer. Diff. Lat.	<u>36</u>

As Co-Sine Course	1 Pt.	9,99157
Is to the Mer. Diff. of Lat.	36	1,55630
So is Sine Course	1 Pt.	9,29024
		<u>10,84654</u>
		9,99157
To the Diff. of Longitude	7.1	<u>0,85497</u>

P

Long.

MERCATOR'S SAILING.

Longitude left	6° 00' W.
Difference of Longitude	7 W.
Longitude in	<u>6 7 W.</u>

Now as the Difference of Longitude being W. it must be set in the Column marked W. and so with the rest, but we shall leave the Operations to exercise the Learner, and proceed to shew how to work the same,

By I N S P E C T I O N.

Look in the Tables under 1 Pt. in the Latitude Column for Meridional Difference of Latitude 36, the nearest is 36,3, against which in the Departure Column stands 7.2 for the Difference of Longitude, which set down as before directed.

In like Manner proceed with the other Courses, and when found, will stand nearly as in the following Traverse Table, always adding or subtracting the Difference of Latitude and Difference of Longitude, as the Case requires, to find the Latitude and Longitude in at the End of each Course; or, without finding the Longitude in at the End of every Course, find the whole Difference of Longitude, and with that and the Longitude left find the Longitude in, which is rather better, as the frequent Omission of Tenths may make a small Difference.

The

The TRAVERSE TABLE.

Courses.	Dist.	Diff. Lat.		Departure.		Lat. in.	Diff. Long.		Lon. in.
		N.	S.	E.	W.		E.	W.	
						50.6 — .23			6.0 + .7
S. by W.	24		23.5		4.7	49.43 — .12		7.1	6.7 + .43
W. S. W.	32		12.2		29.6	49.31 — .26		43.4	6.50 + .49
N. W. $\frac{1}{2}$ W.	41	26.0			31.7	49.57 — .44		48.7	7.39 — .32
S. S. E. $\frac{1}{4}$ E.	49		44.3	21.0		49.13 + .5	32.4		7.7 — .32
E. N. E. $\frac{3}{4}$ E.	19	4.6		18.4		49.18 0.00	32.0		6.35 + .32
* West.	21				21.	49.18 + .23		32.2	7.7 — .43
N. E. $\frac{1}{2}$ E.	36	22.8		27.8		49.41 — .41	42.6		6.24 0
S.	41		41.0			49.0 — 1.25			6.24 + .53
S. S. W.	92		85.0		35.2	47.35 + .36		53.0	7.17 0.00
N.	36	36.0				48.11			7.17
		89.4	206.0	67.2	122.2		106.8	184.4	
		—	89.4		67.2		—	106.8	
		Diff. Lat.	116.6	Dep.	55.	Diff. of Lat.		77.6	

Hence it is plain, that the Ship has made of Southings 116,6, or 117 Miles, = $1^{\circ} 57'$, which being subtracted from the Latitude left $50^{\circ} 6'$, leaves $48^{\circ} 9'$ the Latitude in; and its differing 2 Miles from that in the Table, is owing to the Tenths being so often omitted.

* This must be found by Middle Latitude Sailing.

The Meridian Distance or Departure is 55 Miles West, and the Difference of Longitude 77.6 or 78 Miles = $1^{\circ} 18'$, which being added to the Longitude left $6^{\circ} 0'$ gives $7^{\circ} 18'$ West, the Longitude in, nearly the same as in the Table:

Now to find the direct Course and Distance to the intended Port,

From the Lat. in $48^{\circ} 9'$ Mer. Pts. { 3305 From Long. in $7^{\circ} 18' W.$
Take the Lat. Gibral. $36 12$ { 2333 Take Lon. Gib. $4 53 W.$

11 57 Mer. Dif. Lt. 972
60

2 25
60

Diff. of Lat. 717 Miles

Diff. of Long. 145 Miles

As the Mer. Diff. Lat. 972 2,98767

Is to Radius 10,00000

So is the Diff. of Lon. 145 2,16137

12,16137

2,98767

As S. Com. Cou. $8^{\circ} 29'$ 9,99522

Is to Diff. of Lat. 717 2,85552

So is Radius 10,00000

12,85552

9,99522

To Tang. of Cou. $8^{\circ} 29'$ 9,17370

To the Distance 725 2,86030

Hence the direct Course to Gibraltar is S. $8^{\circ} 29'$ E. or S. $\frac{3}{4}$ E. nearly, and the Distance 725 Miles.

Now to find the Difference of Longitude by the first Rule, or that commonly used at Sea.

Lat. Land's End $50^{\circ} 6'$

Lat. in 48 9

Merid. Parts { 3484

{ 3305

Diff. of Lat. 1 57

Mer. Dif. of Lat. 179

As the Diff. of Lat. 116,6 2,06670

Is to Radius 10,00000

So is the Departure 55 1,74036

11,74036

2,06670

As Co-Sine Cou. $25^{\circ} 15'$ 9,95639

Is to Mer. Dif. of Lat. 179 2,25285

So is S. Course $25^{\circ} 15'$ 9,62999

11,88284

9,95639

To Tang. of Cou. $25^{\circ} 15'$ 9,67366

To the Diff. of Lon. 84,4 1,92645

Long. Land's End $6^{\circ} 0'$

Diff. of Long. 84, or 1 24

Longitude in 7 24

Nearly the same as before

Hence the Difference between the two Methods is 6 Miles, but as Ships never sail so far in 24 Hours, the last Method may be safely

safely depended on for one Day's Run in Latitudes not exceeding 51 or 52 Degrees North or South, as may be seen by comparing the Results of the following Example :

E X A M P L E.

Suppose a Ship from the Latitude $68^{\circ} 38' N.$ and Longitude $8^{\circ} 40' E.$ is bound to the North Cape in Latitude $71^{\circ} 27' N.$ and Longitude $26^{\circ} 30' E.$ sails as in the following Table; what Latitude and Longitude is she in? and her direct Course and Distance to the Cape?

Courses.	Dist.	N.	S.	E.	W.	Lats.in	Diff. Long.	
							E.	W.
N. E. by N.	63	52,4		35,0		$69^{\circ} 30'$	97,2	
N. E.	38	26,9		26,9		69 57	78,0	
N. N. E.	56	51,7		21,4		70 49	64,0	
N.	30	30,0				71 19		
N. W. by N.	25	20,7			13,9	71 40		44,0
N.N.W. $\frac{1}{2}$ W.	36	31,7			17,0	72 12		55,0
N. by E.	40	39,2		7,8		72 51	26,0	
N. E. by E. $\frac{1}{2}$ E.	72	33,9		63,5		73 25	219,4	
S. E.	50		35,3	35,3		72 50	120,6	
E. N. E.	65	24,9		60,0		73 15	207,0	
		311,4	35,3	249,9	30,9		812,2	99,0
		35,3		30,9			99,0	
Diff. Lat.	=	276.1		219,0	Dep.	Di. Lo.		

With 1 Tenth the Difference of Latitude and Departure, viz. 27.6 and 21.9 the Course is N. $38,30 E.$ and Distance 353 Miles.

The Meridional Difference of Latitude is 852, with which and the direct Course $38^{\circ} 30'$, the Difference of Longitude is 676, being 37 Miles too little; a Quantity considerable enough to produce fatal Consequences.

Lat. left	$68^{\circ} 38' N.$	Long. left	$8^{\circ} 40' E.$
Diff. of Lat.	4 36 N.	Diff. Long.	11 53 E.
Lat. in.	73 14 N.	Long. in	20 33 E.
Lat. of N. Cape	71 27 N.	N. C. Long.	26 30 E.
Diff. of Lat.	1 47 N.	Diff. Long.	5 57 E.
Or	107 Miles,	Or	357 Miles

NOTE. The North Cape in this Edition is placed in Lat. $71.10 N.$ and Long. $26,15 E.$

Now

Now to Meridional Difference of Latitude 353, and Difference of Longitude 357, the Course is N. $45^{\circ} 20'$ E. and to Course 45, 20, and proper Difference of Latitude 107, the Distance is 152 Miles.

Hence the direct Course to the Cape is N. E. nearly, and Distance 152 Miles.

Having gone through the necessary Problems in Mercator's Sailing, we shall now proceed to shew how the true Chart, commonly called Mercator's Chart, may be constructed either for the Whole, or any Part of the Terraqueous Globe.

When a Chart is to commence from the Equator, or if the Equator is to run through it.

Having provided a Scale of convenient length, draw a Line to represent the Equator, and crossing that at Right Angles, another to represent the Meridian of some known Place, such as London, Paris, the Lizard, or any other Place whose Longitude is known; the upper End of which will represent the North, and the lower the South.

From the Scale take 60 in your Compasses, and with one Foot upon the Meridian, set off that Distance on both Sides of it upon the Equator, if the Chart is to contain East and West Longitude; but, if it is only to contain East or West Longitude, lay it off upon that Side of the Meridian the Case requires: that is, if the Longitude is to be Westward, lay it off on the Left Hand Side of the Meridian: but if Easterly, the Right Hand Side.

Again, take 2 Degrees or 120 Miles in your Compasses, and set it off from the Meridian, in the same Manner as before, or, with 60 Miles in the Compasses, turn over from the Meridian, and that will point out the Degrees of Longitude, which may be divided into Halves, Quarters, or Minutes, if required.

Having set off as many Degrees of Longitude as you intend the Chart should contain, through the last draw a Line, (or Lines) parallel to the Meridian, which will be the Bounds of the Chart East and West.

Having divided the Equator as above, proceed to set off upon the two extreme Meridians from the Equator, the Meridional Parts (as found in the Table) belonging to each Degree of Latitude; that is, take from the Scale in Compasses, the Miles answering to one Degree in the Table, and with one Foot in the Equator, set off that Distance on each Side of it upon the extreme Meridians, if the Chart is to contain North and South Latitude; but if only North or South, upon one Side of the Equator.

Again,

Again, take the Meridional Parts answering to 2 Degrees and 3 Degrees, &c. in your Compasses, and set them off upon the Meridian from the Equator, as before.

In like Manner proceed to set off as many Degrees as you intend the Chart should contain; or, which will be the same Thing, take the Meridional Difference of Latitude between any two Parallels, and set them off severally from the least Latitude.

Lay a Ruler on each of these Divisions, and draw Lines parallel to the Equator, and they will be the Parallels of Latitude; each of which will be enlarged towards the Poles, in Proportion as the Degrees of Longitude are.

Parallel to the Meridian, draw Lines through the Points, expressing the Degrees of Longitude, to cut the Parallels of Latitude, which bound the Chart North and South.

The Parallels of Latitude may also be divided into Halves, Quarters, or Minutes, by taking the Meridional Parts for Degrees and Minutes, and setting them off as before.

Draw double Lines on the Borders of the Chart, and mark out the Degrees of Latitude and Longitude; and, in some convenient Place draw the Compass. In like Manner may a Chart be made that shall contain any Number of Degrees and Minutes required. When the Chart is not to commence from the Equator, but is only to serve from a certain Distance on the Meridian, between two Parallels on the same Side of the Equator, then the Meridians are to be drawn as before; and for the Parallels of Latitude you are to proceed thus:

From the Meridional Parts answering to each Point of Latitude in your Chart, subtract the Meridional Parts answering to the least Latitude, and set off the Difference severally from the Parallels of the least Latitude upon the two extreme Meridians, and the Lines joining these Points of the Meridian will represent the several Parallels upon the Chart.

Let it be required to draw a Chart that shall serve from the Latitude of 14 Degrees North, to 52 Degrees North, and that shall contain 1 Degree East, and 26 Degrees of Longitude West of the Meridian of London.—See the Chart.

Draw a Line to represent the Meridian of London, from which set off 60 Miles towards the Right Hand, for 1 Degree of Longitude, and on the other Side towards the left Hand set off 26 Degrees of West Longitude, as before directed: through the two last Points draw Lines Parallel to the Meridian of London, and these will be the extreme Meridians, or East and West Bounds, of your Chart.

Having drawn the two Meridians on the lower Edge of the Paper, draw a Line perpendicular to the Meridians, to represent the Parallel

Parallel of 14 Degrees North; then from the Meridional Part answering to 15 Degrees 910, subtract the Meridional Parts answering to 14 Degrees 848, and take the Difference 62 in your Compasses, and set it off from the Parallel on both the Meridians from you, and that will represent the Parallel of 15 Degrees.

Again, take the Meridional Parts of 15 Degrees 910, from the Meridional Parts of 16 Degrees 973, and set off the Difference 63, upon the Meridians from the Point representing the Parallel of 15 Degrees, and that will represent the Parallel of 16 Degrees. In like Manner proceed to set off the Parallels upon the Meridians.

Or, if the Meridional Parts of 14 Degrees be subtracted from the Meridional Parts of every succeeding Parallel, and the Difference be set off from the Parallel of 14 Degrees upon the Meridians, these Points will represent the several enlarged Parallels of Latitude, the same as before; and, if it is required that the Meridians should be divided into Degrees and Minutes, the Meridional Parts for such must be taken from the Table, and set off as above.

Having set off as many Parallels as you intend the Chart should contain, through each Point draw Parallels, or if you think drawing Lines through every Degree will crowd your Chart too much, you may divide the Borders only into single Degrees, &c. and draw Lines through every 5 Degrees of Latitude and Longitude, as in the Chart,

Take from the Table of Latitude and Longitude of Places, the Latitude and Longitude of each particular Place contained within the Bounds of the Chart, and lay a Ruler over its Latitude, and another, crossing that, over its Longitude, the Point where these cross will represent the proposed Place upon the Chart. In like Manner may any Place be readily marked. Hence, the particular Points of a Sea Coast being laid down as above, and Lines properly drawn from Point to Point, will form the Out-lines of the Sea Coasts, Islands, &c. to which may be annexed, the Depths of Water, Setting of Currents, and whatever else may be thought convenient for the Chart to contain.

This Map or Chart is not to be considered as a just or similar Representation of the Earth's Surface, for in it the Figures of Islands and Countries are distorted near the Poles. For,

Suppose an Island in the Latitude 60 N. or S. where the Breadth of a Degree of Longitude is just half as large as a Degree upon the Equator. Now as the Degrees of Latitude are enlarged in Proportion as the Degrees of Longitude are expanded towards the Poles, it is plain, that every Point of that Island or Country, being laid down in its proper Latitude and Longitude, will be represented twice as large as it really is.

Hence it follows, that as the Degrees of Latitude are every where increased like those of Longitude, it is plain the Bearings between Places will be the same on this Chart as on the Globe; and the Proportions

portions between the Latitude and Longitudes and Nautical Distances, will be the same upon this Chart as upon the Globe.

And since the Meridians in this Projection are Right Lines, it follows, that the Rhumbs which form equal Angles with the Meridians will be strait Lines, which renders this Projection of the Earth's Surface much more easy and proper for the Mariner's Use, than any other.

Gunter's Scales have drawn upon them 2 Lines, one marked N M. signifying the Nautical Meridian; and the other directly under it marked E. P. signifying equal Parts or Degrees of Longitude upon a Mercator's Chart.

Those are Equal Parts or Degrees of Longitude, to which the Degrees of the Nautical Meridian are fitted, by increasing them in their true Proportion; hence the Limits or Bounds of a Mercator's Chart by these Lines are easily made, by transferring the Divisions corresponding to the Degrees to be used, from the Scale to the Paper the Chart is to be drawn upon: but as the Degrees drawn by these Lines are too small for the Seaman's Use, it is much better to use a Scale of equal Parts as before, and consequently the Degrees may be made of any proposed Length.

By the Latitude and Longitude in, to prick off the Ship on the Chart.

RULE. Lay the Ruler across the Chart in the Latitude your Ship is in, then look upon the Equator, or Line marked with the Degrees of Longitude, for the Longitude your Ship is in by your Reckoning, and setting one Foot of your Compasses in that Longitude, take the nearest Distance to some North and South Line, and from where that Line crosses the Edge of the Ruler that lies in the given Latitude; lay off that same Distance along the Edge of the Ruler to the Right Hand, if the Longitude you are in was to the Right Hand of the North and South Line, or to the left Hand, if it was to the left Hand; where this falls will be the Place of the Ship: But this will only do when the Longitude marked on the Chart, and your Reckoning of Longitude in, are both counted from the same Meridian. Therefore, for a general Rule, take the following, viz.

By the Latitude in, and Longitude made, to prick off the Ship's Place.

RULE. Set one Foot of your Compasses in the Place you take your Departure from, and take the nearest Distance to some North or South Line, and from where that Line falls upon the Equator, or the Line marked with the Degrees of Longitude, set off that Distance the same Way the Place lies from it; that is, to the right Hand, if the Place lies to the right Hand of the North and South Line, or to the left Hand, if it lies to the West; and make a Mark with a Black lead Pencil; this Mark will serve to prick off

by, till you come to take a new Departure ; and then rub it out, and make a new one as before.

Then lay a Ruler across the Chart in the Latitude you are in, and taking so many Degrees in your Compasses from the Line of Longitude, as your Longitude made comes to, set them off from your Black lead Mark along the Edge of the Ruler to the Eastward ; if the Longitude made be East, or to the Westward if it be West ; where this falls will be the Longitude the Ship is in by the Chart ; from which take the nearest Distance to some North and South Line, and from where that Line, &c. as in the first Case.

The Ship's Place on the Chart being found, as before taught, it remains in the next to shew how to find the Bearing and Distance of any Place from the Ship ; and first,

To find how any Place bears from the Ship.

RULE. Lay a Ruler from the Place of the Ship to the Place you would know the bearing of ; then set one Foot of the Compasses in the Centre of some Compass near the Ruler, and take the nearest Distance to the Edge of the Ruler ; then run one Foot of your Compasses along by the Edge of the Ruler, and observing what Point of the Compass the other comes nearest to, which will be the Bearing required.

To find the Distance of any Place from the Ship.

C A S E I.

If the Place be in the same Longitude that the Ship is in, that is, if it bears due North or South, then the Difference of Latitude between them, turned into Miles or Leagues, will be the Distance.

C A S E II.

If the Place be in the same Latitude the Ship is in, that is, if it bears due East, or due West, then take Half the Distance between the Ship and the Place in your Compasses ; and setting one Foot on the Line marked with the Degrees of Latitude, in the Latitude the Ship is in, see what Latitudes the other Foot will reach to, both above and below it ; the Difference between these two Latitudes will be the Distance required.

C A S E III.

When they are neither in the same Latitude nor in the same Longitude with the Ship.

RULE. Take the Difference of Latitude between both Places in your Compasses from the Equator, or graduated Parallel ; and laying a Ruler over both Places, put one Foot on the Ship's Place, and
slide

slide your Compasses along the Edge of the Ruler (holding both Points parallel to the Meridian) until the other cuts the Parallel of Latitude passing through the Place, (or E. and W. Line cut by the Ruler) and then stay the Compasses. Take the Distance between where the Point rested by the Edge of the Ruler and the Place (or where the Ruler crossed the aforesaid East and West Line) in your Compasses, and apply it to the Equator, or graduated Parallel, and that will give their Distance in Degrees, which may be turned into Miles or Leagues; and in the same Manner as you find the Bearing and Distance between the Ship and any Place, you may also find the Bearing and Distance of one Place from another; or if the Distance between the Ship and Place be taken in your Compasses, and applied to the Side of the Chart, or graduated Meridian, nearly in the Parallels of the Ship and Place, will give the Distance in Degrees as before; and for this Purpose there are generally marked on the Sides of Charts Scales of Leagues, by which the Distances between Places may be readily found.

EXAMPLE.

Required the Bearing and Distance between Cape St. Vincent and Teneriff?

Lay a Ruler over both Places, and take their Difference of Latitude $8^{\circ} 30'$, from the Equator or graduated Parallel, in your Compasses; and slide one Foot along the Edge of the Ruler from Teneriff, holding the other Point in the Direction of the Line C B, until the other Point just touches the East and West Line, (A B) passing through St. Vincent, as at B, from C where the Foot of the Compasses rested, by the Edge of the Ruler, and St. Vincent being measured, and applied to the graduated Parallel, gives 10 2-third Degrees, or 640 Miles the Distance.

Again, take the nearest Distance between the Centre of the Compass in your Compasses, and sliding them along the Edge of the Ruler as before directed, you will find the Course to be S. W. by S. $\frac{1}{4}$ W. nearly.

Hence the direct Course between Cape St. Vincent and Teneriff is S. W. by S. $\frac{1}{4}$ W. Distance 640 Miles, or 213 1-third Leagues; and the same with other Places.

Q 2

OBLIQUE

O B L I Q U E S A I L I N G.

WE come next to the Doctrine of Oblique Triangles applied to Problems of Sailing; and though it may be applied to the measuring of inaccessible Objects, yet we shall confine it to those Problems which are more immediately necessary in Navigation; and is chiefly used in taking the Maps of Harbours, Sea-Coasts, &c. as follows:

C A S E I.

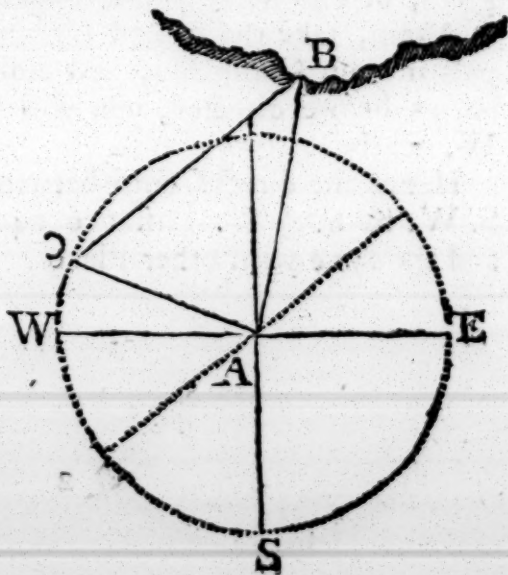
Coasting along the Shore, I saw a Cape of Land, which bore from me N. by E. then I stood away W. N. W. 5 Leagues, or 15 Miles, and the same bore from me N. E. half E. I demand the Distance of the Ship from the last Station to the Cape?

By P R O J E C T I O N.

Having drawn the Compass N. E. S. W. let A represent the Place of the Ship in her first Station, and draw the W. N. W. Line AC, equal to 15 Miles, then will C be the Place of the Ship in her second Station.

From C, draw the Line C B parallel to the N. E. half E. Line, till it meets the N. by E. Line A B, in B; then will B represent the Cape of Land, and C B the Distance of the Ship at her second Station.

In the Triangle A B C are given A C equal to 15 Miles, the Angle A $78^{\circ} 45'$ equal to 7 Points, the Distance between the N. by E. and W. N. W. the Angle B equal to $39^{\circ} 22'$ or $3\frac{1}{2}$ Points, the Distance between the N. by E. and N. E. $\frac{1}{2}$ E. and the Angle C equal to $61^{\circ} 53'$ or $5\frac{1}{2}$ Points, the Distance between the W. N. W. and S. W. $\frac{1}{2}$ W.



Whence

Whence to find the Distance C B, it will be,

As the Sine Angle B	————	39° 23'	9.80228
Is to the Side A C	————	15 Miles	1.17609
So is Sine Angle A	————	78° 45'	9.99157
			11.16766
			9.80228

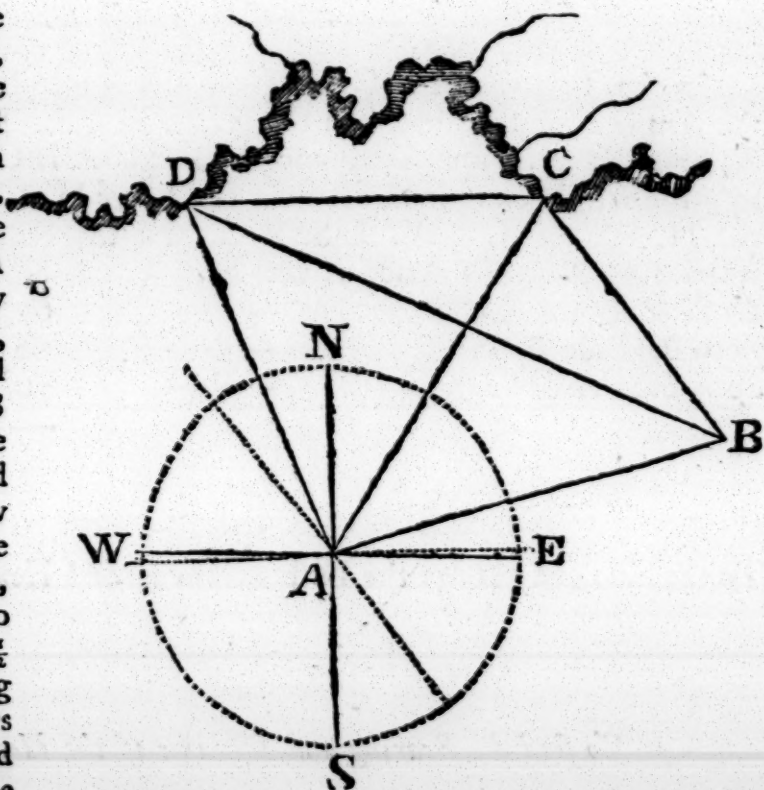
To the Side C B 23.19, to the Distance of the Ship }
from the Cape at her second Station 1.36538

C A S E II.

Coasting along the Shore, I saw two Head-lands, the first bore N. N. W. the second N. N. E. $\frac{3}{4}$ Easterly, then standing away E. by N. $\frac{1}{2}$ Northerly, 16 Miles, the first bore from me W. N. W. the second N. W. by N. $\frac{1}{4}$ Westerly.

I demand the Distance of each of these Head-lands from the first Place, as also their Bearing and Distance from each other ?

Having drawn the Compass as before, let A represent the Ship at her first Place, from which draw the N. N. W. Line A D and the N. N. E. $\frac{3}{4}$ E. Line A C, and also the E. by N. $\frac{1}{2}$ N. Line A B, which make equal to 16 Miles, then B will represent the Ship at her second Place; from B draw B D parallel to the W. N. W. Line, and B C parallel to the N. W. by N. $\frac{1}{4}$ W. Line, meeting the two first Lines in the Points C and D, then D will be



the first, and C the second Head-land; join the Points D and C, and D C will be their Distance asunder. Then draw a Line parallel to D C thro' the Centre of the Compass, and that will shew their Bearings from each other; to find which

By

By CALCULATION.

To find the Distance of the first Head-land.

In the Triangle D A B are given the Angle D A B $8\frac{1}{2}$ Points = $95^{\circ} 37'$, the Angle contained between the N. N. W. Line A D, and E. by N. half N. Line A B, and the Angle A B D $3\frac{1}{2}$ Points = $39^{\circ} 22'$ the Angle contained between the E. by N. half N. Line A B, and W. N. W. Line B D, and A B 16 Miles, whence by Axiom second, it will be,

As Sine Angle A D B	————	$45^{\circ} 1'$	9,84961
Is to the opposite Side A B	————	16	1,20412
So is Sine A B D	————	$39^{\circ} 22'$	9,80228
			11,00640
			9,84961

To the Side A D 14.35 the Dist. of the first Head-land

1,15679

To find the Distance of the second Head land.

In the Triangle A B C are given the Angle B A C $3\frac{3}{4}$ = $42^{\circ} 11'$, the Angle contained between the N. N. E. $\frac{3}{4}$ E. Line A C, and the E. by N. $\frac{1}{2}$ N. Line A B, and the Angle A B C $6\frac{1}{4}$ Points = $70^{\circ} 19'$, the Angle contained between the E. by N. $\frac{1}{2}$ N. Line A B, and the N. W. by N. $\frac{1}{4}$ W. Line B C, and the Side A B 16 Miles, whence by Axiom second, it will be,

As Sine Angle A C B	————	$67^{\circ} 30'$	9,96561
Is to the Side A B	————	16	1,20412
So is Sine Angle A B C	————	$70^{\circ} 19'$	9,97385
			11,17797
			9,96561

To the Side A C 16.31 the Dist. of the second Head-land

1.21236

To find the Bearing and Distance of the Head-lands.

In the Triangle D A C are given the Side A C 16.31, the Side A D 14.35, and the Angle D A C $4\frac{1}{4}$ Points = $53^{\circ} 26'$, the Angles contained between the N. N. W. Line A D, and the N. N. E. $\frac{3}{4}$ E. Line A C, whence to find the Angles A D C, or A C D,

The

O B L I Q U E S A I L I N G .

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The Side A C	16,31	Angle D A C	180° 00'
The Side A D	14,35		53 26
Sum of the Sides	30,66	Sum Angles	126 34 opposite the Sides.
Difference of Sides	1,96	Half Sum of ditto	63 17 } then by Axiom third it will be
As the Sum of the Sides A C and A D	— 30,66		1,48657
Is to their Difference	— 1,96		0,29226
So is T. of $\frac{1}{2}$ the Sum of Angles A D C and A C D	63° 17'		10,29816
			10,59042
			1,48657
To the Tangent of half their Difference	7° 14'		9,10385

Then $63^{\circ} 17'$ added to $7^{\circ} 14'$ is $70^{\circ} 31'$, the greater Angle A D C, and $63^{\circ} 17' - 7^{\circ} 14' = 56^{\circ} 3'$ the Angle A C D.

Now the Angle A D C $70^{\circ} 31'$ added to $22^{\circ} 30'$, the Angle contained between the N. N. W. Line A D, and the Meridian gives $93^{\circ} 1'$, which being more than a Right Angle, shews that D bears from C, W. $3^{\circ} 1'$ Southerly, and consequently C bears from D East $3^{\circ} 1'$ Northerly.

For the Distance by Axiom II. it will be.

As the Sine of the Angle A D C = $70^{\circ} 31'$	—	9,97439
Is to the Side A C	16 31	1,21245
So is Sine Angle D A C	53° 26'	9,97439
		11,11725
		9,90480
To the Side D C	13,9 the Dist. between the Head-lands	1,14286

All the above Proportions may be worked by Gunter's Scale, but they are more readily done by Projection.

After this Manner may the mutual Bearings and Distances of any Number of Head-lands be found; as also the Maps of Harbours, Sea Coasts, &c. which are of excellent Use in reconnoitering the Enemy's Coasts, Towns, &c without venturing too near their Forts.

Many

Many more Examples might be produced, which are not of much Use at Sea, and therefore are omitted.

There is a Method of ascertaining the Distances of Places by Sound, which is as follows: Fix a Pendulum of 38.2 Inches upon a Peg or Nail, and giving it a swing, every Time it passes the Centre will give Seconds; and as it is found by many Experiments, that Sound travels 1142 Feet in one Second; therefore the Difference of Time between seeing the Flash and hearing the Sound being measured by the Pendulum, the Distance may be easily found by allowing 1142 Feet for every Second, or allowing $9\frac{1}{4}$ Half Seconds to travel an English Mile, or five Seconds three Tenths to travel a Geographical Mile. If a Stop Watch is at Hand it will answer the Purpose better.

E X A M P L E.

Being at Sea I counted 50 Seconds between the Time of seeing the Flash of a Gun and hearing the Report. I demand the Distance?

If 50 Seconds be divided by 5.3, the Quotient 9.3 Miles, will be the Distance required; or if the same Number of Seconds, viz. 50, be divided by 16, the Quotient 3 one eighth Leagues, will give the Leagues of Distance, so that the Gun, when it was fired, was 9.4 Miles, or 3 Leagues, and one eighth from the Observer.

Hadley's Quadrant or a Sextant will be found more convenient for taking the Angular Distances of Objects in running along a Coast, when the Angles do not exceed 90° or 120° as they can be more accurately and expeditiously taken, and the Draught of a Sea Coast or Harbour, as well as the Distances of Objects, be determined with sufficient Exactness; For having a Base or Stationary Line, accurately measured, and the Angles taken from different Parts of it, the Intersections of the Line, including these Angles, will determine the several Points of the Coast or Harbour, and sketches may be drawn to represent the appearance of the Land, &c. If Time will permit the Soundings, Rocks, &c. may be taken in a Boat, and the Bearings of the whole afterwards laid down by the Compass. Even such a rough Draught as the above will be of great Use in giving an Idea of Coasts and Harbours of any Country we chance to fall in with, and if the Mariner has a Taste for Drawing he may give a pretty good Description of the Parts he has been at, a Thing but too much neglected by our English Seamen.

CURRENT SAILING.

CURRENTS are certain Settings of the Stream, by the Means of which all Bodies moving therein, are compelled to alter their Course, and submit to the Motion impressed upon them by it.

Whence, if a Current sets with the Course of the Ship, it augments her Motion by as much as the Drift or Rate of driving it.

Thus, if a Ship sails N. N. E. 20 Miles in a Current that sets N. N. E. 8 Miles in the same Time, her true Course will be N. N. E. 28 Miles in that Time; but if a Current sets against the Ship, it lessens her Velocity by just so much as the Current's Drift is.

So that if a Ship sails N. E. 49 Miles, in a Current that sets S. W. 10 Miles in the same Time, then her true Course will be N. E. 39 Miles; and if, in the same Time that the Ship sails N. E. 49 Miles, in a Current that sets S. W. 59, then the Ship will fall a-stern, and her true Course will be S. W. 10 Miles; but if the Ship thwarts the Current, it not only lessens or augments her Velocity, but gives her a new Motion compounded of that of the Ship and Current; that is,

If a Body be agitated by two Motions at the same Time, the one with a certain Velocity, that will carry it according to the Direction of the Line A B, the Length A B in a certain Space of Time;



the other according to the Direction of the Line A D, with a Velocity that will carry it to the Distance A D in the same Time; then the Body will describe the Diagonal A C, and at the End of that Time will be found in the Point C.

The Setting and Drift of the most remarkable Tides and Currents are pretty well known; but if in unknown Currents, the usual Way to find the Setting and Drift, is thus:

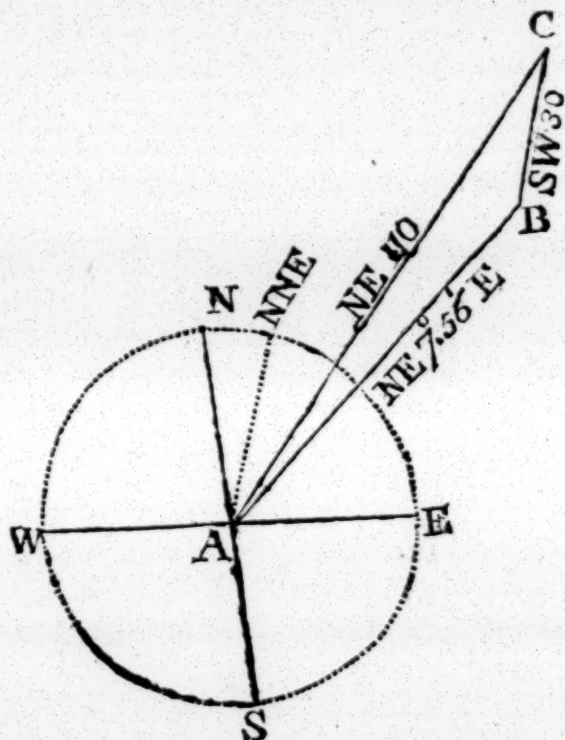
Let three or four Men take a Boat a little way from the Ship, and by a Rope fastened to the Boat's Stem, let down a heavy Iron Pot, or loaded Kettle, into the Sea to the Depth of 80 or 100 Fathoms, when it can be, whereby the Boat will ride almost as steady as at Anchor; then heave the Log, and the Number of Knots run out in Half a Minute, will give the Miles which the Current runs per Hour, and the Bearing of the Log shews the Setting of the Current.

EXAMPLE I.

If a Ship sails N. E. 110 Miles in a Current that sets S. S. W. 30 Miles in the same Time, and her true Course and Distance be required?

By PROJECTION.

Set off 4 Points from N. towards E. and draw A C equal to 110 Miles; from C draw C B parallel to the N. N. E. Line, and equal to 30 Miles draw A B, which will be the Ship's true Course.



By CALCULATION.

In the Triangle A B C are given the Side A C 110, the Side B C 30 Miles, and the Angle A C B $22^{\circ} 30'$, by Axiom III.

The Side A C	110	$180^{\circ} 0'$
C B	30	$22^{\circ} 30'$

The Sum of the Sides 140 the Sum of Angs. A & B $157^{\circ} 30'$ opp. these Sides

Their Difference $80^{\circ} \frac{1}{2}$ the Sum of the Ang. $78^{\circ} 45'$ CAB and ABC

As the Sum of the Sides A C and A B 140	2,14613
Is to their Difference 80	1,90309
So is the T. of $\frac{1}{2}$ the Sum of Angs. CBA and BAC $78^{\circ} 45'$	10,70134

12,60443
2,14613

To the Tangent of Half their Difference $70^{\circ} 49'$

10,45830

CURRENT SAILING. 131

Half the Sum of the Angles C A B and C B A	78° 45'
Half their Difference	70 49
Which being added gives the greatest Angle C B A	149 34
But if subtracted, the lesser C A B	7 56

Hence it appears that the Course is N. E. 7° 56' Easterly.

To find the Distance by AXIOM II, it will be,

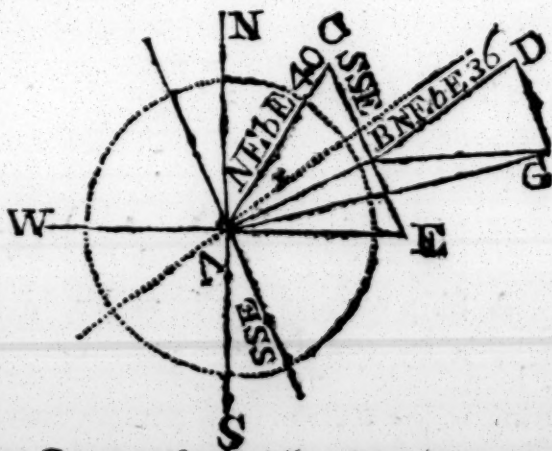
As Sine Angle B 149° 34'	9,70461
Is to the Side A C 110	2,04139
So is Sine Angle C 22° 30'	9,58284
	11,62423
	9,70461
To the Distance run 83,2	1,91962

EXAMPLE II.

If a Ship from the Latitude 36° 30' S. sails N. E. by N. 40, then N. E. by E. 36 Miles, in a Current that sets S. S. E. 20 Miles; in the same Time that the Ship sails 38 Miles; and it be required to find the Distance between the Ship and her first Place, as also the Latitude the Ship is in?

By PROJECTION.

Having drawn the Compass, as before, draw the N. E. by N. Line equal to 40 Miles; upon the End of which draw a Line parallel to the S. S. E. upon which set off 21 Miles; the Distance the Current sets while the Ship runs 40 Miles; then draw the N. E. by E. Line, upon which set off 36 Miles, at the End of that draw the S. S. E. Line, on which set off 18.9 Miles, the Distance the Current sets while the Ship runs 36 Miles; then from the End of that Line to the Ship's first Place



Place will be the Distance; and the Angle being measured, will be the Ship's Course, and a Line drawn from the Ship's last Place, parallel to the E. and W. till it cuts the Meridian; that being measured from the Ship's first Place will be the Miles of Difference of Latitude.

This may be done by Calculation, but it being tedious, we shall omit it, and shew how it may be done by a Traverse, in which we shall consider the Current as a single Course.

Courses.	Differ. of Lat.			Departure.	
	Dist.	N.	S.	E.	W.
N. E. by N.	40	33,3		22,2	
N. E. by N.	36	20,0		29,9	
S. S. E.	40		37,0	15,3	
		53,3			
		37,0		67,4	Depart.
Differ. of Lat.		16,3			

Having the Difference of Latitude and Departure, to find the Course and Distance.

As the Diff. of Lat.	16,3	1.21219	As the S. Course	76° 24'	9.98765
Is to Radius		10.00000	Is to Departure	67.4	1.82666
So is Departure	67.4	1.82866	So is Radius		10.00000
		11.82866			11.82866
		1.21219			9.98765
To Tang. Course	76° 24'	10.61647	To the Distance	69.3	1.84101

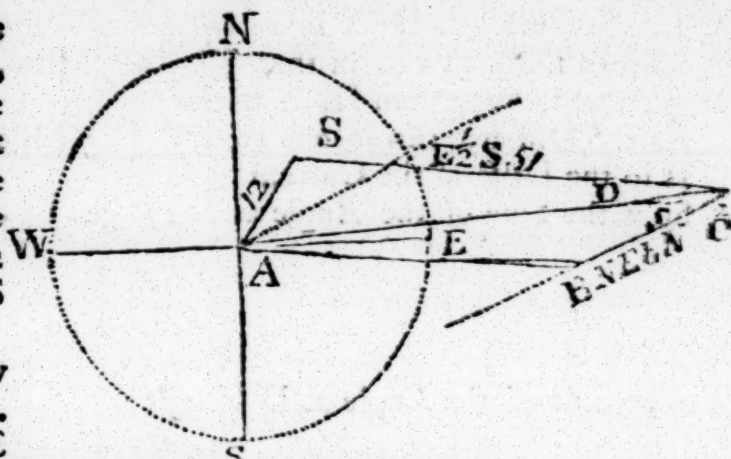
E X A M P L E III.

A Ship coming out from Sea in the Night, has Sight of Scilly Light, bearing N. E. by N. Distance 4 Leagues; it being then Flood Tide, setting E. N. E. 2 Miles an Hour, and the Ship running at the Rate of 5 Knots an Hour; I demand upon what Course she must steer, and how far to hit the Lizard, it bearing from Scilly E. half S. Distance 17 Leagues?

By

By INSPECTION.

Having drawn the Compass, as before, let A represent the Place of the Ship at Sea, and draw the N. E. by N. Line A S. equal to 12 Miles, then will S represent Scilly.



2dly. From S draw S L equal to 51 M. and parallel to the E half S. Line, then will L be the Place of the Lizard.

3dly. Draw L C parallel to the W. S. W. Line equal to 2 Miles, and C D equal to 5 Miles; and parallel to it, draw A B till it meets L C produced in B, then will A B be the Distance required, and the Angle S A B the true Course.

By CALCULATION.

In the Triangle A S L are given A S equal to 12 Miles, S L equal to 51 Miles, and the Angle A S L $118^{\circ} 7'$ equal to 10 Points, and half, the Distance between the N. E. by N. and W. half N. whence to find the Angle S A L, by Axiom III, it will be,

As the Sum of the two Sides A S and S L 63	1.79934
Is to their Difference 39	159106
So is Tan. of Half the Angles S A L and S L A $30^{\circ} 56'$	9.77763

11,36869
1.79934

To the Tan. of Half their Difference	$20^{\circ} 21'$	9.56935
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Whence the Angle S A L will be found $\pm$ to $51^{\circ} 17'$, and consequently the direct Course from the Ship to the Lizard is N. $85^{\circ} 2'$ E. or E. by N. $6^{\circ} 17'$ Easterly.

To find the Distance A L by Axiom II. it will be,

As the Sine Angle S A L $51^{\circ} 17'$	9.89223
Is to the Distance from Scilly to the Lizard 51	1.70757
So is the Sine of the Angle A S L $118^{\circ} 7'$	9.94546

11.65303
9.89223

To the Distance between the Ship and Lizard 57,65	1.76080
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In the Triangle D L C are given the Angle $L = 17^{\circ} 32'$, the Distance between the E. N. E. and the N. $85^{\circ} 2' E.$ The Side C L, the Current's Drift in an Hour $= 2$ Miles, and the Side C D, the Ship's Distance run in that Time $= 5$ Miles, whence to find the Angle at D, by Axiom II. it will be,

As the Distance run in one Hour C D 5 Miles	0,69897
Is to the Drift of the Current 2 Miles	0,30103
So is the Sine of the Angle at L $17^{\circ} 32'$	9,47894
	9,77997
	0,69897

To the Sine of the Angle at D $6^{\circ} 55'$ 9,08100

Hence, because the Angle C D L is $=$ B A L, the Course the Ship must steer is S. $88^{\circ} 33' E.$

To find the Distance A B, by Axiom II. it will be,

As the Sine Angle at B $153^{\circ} 33'$	9,61689
Is to the Distance between the Ship and Lizard 57,65	1,76080
So is the Sine of the Angle at L $17^{\circ} 32'$	9,47894
	11,23974
	9,61689

To A B the Distance she must sail 41,96 1,62285

Many more Questions might be added, but these, being well understood, are sufficient for the Seaman's Purpose; and that the Student should not meet with any Thing unnecessary which might lead him out of the plain Path, I have avoided those Things which tend to puzzle more than improve; therefore would advise him to be well acquainted with every written Article; and that nothing may be wanting to complete the Artist, I shall proceed to the Rules necessary for keeping a Journal at Sea.

O F W I N D S.

THE Sun, that amazing Globe of Fire, the Fountain of Light, and Heat of the whole solar System, whose Rays upon the Earth cause Vapours or Fumes to be continually rising from it, which must partake of the Quality of those Parts from whence they are evaporated; a Collection of which form what we call our Air or Atmosphere, surrounding the Earth, and extending some Miles above its Surface, and is liable to be put in Motion by various Causes. Hence Air is a fine elastic Fluid, and is found capable of being compressed, or condensed by Cold, and expanded or rarefied by Heat.

Consequently, an Alteration of Heat or Cold happening in any Part of the Atmosphere, the Air in that Part will be either condensed or rarified, and the neighbouring Parts will thereby be put into Motion, through the Endeavour which the Air by its Elasticity or Springiness, always makes to restore itself to its former State, or come to an Equilibrium.

Wind is a Stream or Current of Air, which generally blows from one Part of the Horizon to its opposite Part.

The following Observations have been made on it, particularly by Dr. Halley, which are not unworthy the Seaman's Notice.

Between 30 Degrees North Latitude, and 30 South Latitude, there is a constant East Wind throughout the Year, blowing on the Atlantic and Pacific Oceans, and this is called the Trade Winds.

For as the Sun, in moving from East to West, heats the Air more immediately under him, and thereby expands it; the Air to the Eastward is constantly rushing towards the West to restore the Equilibrium or natural State of the Atmosphere, which occasions a perpetual West Wind in those Limits.

The Trade Winds near these Northern Limits, blow between the North and East, and near the Southern Limits they blow between the South and East.

For as the Air is expanded by the Heat of the Sun near the Equator, therefore the Air from the Northward or Southward will both tend toward the Equator to restore the Equilibrium; now these Motions from the North and South, joined with the foregoing Easterly Motion, will produce the Motions observed near those Limits between the North and East, and between the South and West.

These Winds, if the whole Surface of the Globe were Sea, would undoubtedly blow quite round it, as they are found to do in the Atlantic and Ethiopic Oceans; but seeing such great Continents intetpose and break the Continuity of the Ocean, regard
must

must be had to the Nature of Soils, and the Position of high Mountains, which are the principal Causes of the Variety of Winds differing from the former general one.

In some Parts of the Indian Ocean there are periodical Winds, which are called Monsoons; that is, such as blow half the Year one Way, and the other Half-year the contrary Way.

For Air that is cool and dense will force the warm and rarefied Air in a continual Stream upwards, where it must spread itself to preserve the Equilibrium; so that the upper Course or Current of the Air shall be contrary to the under Current; for the upper Air must move from those Parts where the greatest Heat is, and so by a Kind of Circulation, the N. E. Trade Wind below, will be attended with a S. W. above, and a S. E. below, with a N. W. above: And this is confirmed by the Experience of Seamen, who, as soon as they get out of the Trade Winds, immediately find a Wind blowing from the opposite Quarter.

In the Atlantic Ocean, near the Coasts of Africa, at about 100 Leagues from Shore between the Latitudes of 28° and 10° North, Seamen constantly meet with a fresh Gale of Wind blowing from the N. E.

Those bound to the Caribbee Islands, across the Atlantic, find, as they approach the American Side, that the said N. E. Wind becomes Easterly, or seldom blows more than a Point from the East either to the Northward or Southward.

These Trade Winds on the American Side are extended to 30° , 31° , or even to 32° of North Latitude; which is about 4° farther than what they extend to on the African Side; also to the Southward of the Equator, the Trade Winds extend 3 or 4 Degrees farther towards the Coast of Brazil on the American Side, than they do near the Cape of Good Hope on the African Side.

Between the Latitudes of 4 Degrees North, and 4 South, the Wind always blows between the South and East: On the African Side the Winds are nearest the South, and on the American Side nearest the East. In these Seas Dr. Halley observed, that when the Wind was Eastward, the Weather was gloomy, dark, and rainy, with hard Gales of Wind; but when the Wind veered to the Southward, the Weather generally became serene, with gentle Breezes next to a Calm.

These Winds are somewhat changed by the Seasons of the Year; for when the Sun is far Northward, the Brazil S. E. Wind gets to the South, and the N. E. Wind to the East; and when the Sun is far South, the S. E. Wind gets to the East, and the N. E. Wind on this Side of the Equator veers more to the North.

Along the Coast of Guinea, from Sierra Leona to the Island of St. Thomas under the Equator, which is above 500 Leagues, the South-ealy and South-west Winds blow perpetually; for the S. E. Trade Wind having passed the Equator, and approaching the Guinea Coast, within

within 80 or 100 Leagues, inclining towards the Shore, and becomes S. S. E. then South, and by Degrees as it comes near the Land, it veers about to S. S. W. and in with the Land it is S. W. and sometimes W. S. W. This Track is troubled with frequent Calms, and violent sudden Gusts of Wind, called Tornadoes, blowing from all Points of the Horizon.

The Reason of the Wind setting in West on the Coast of Guinea, is, in all Probability, owing to the Nature of the Coast, which being greatly heated by the Sun, rarefies the Air exceedingly, and consequently, the cool Air from off the Sea, will keep rushing in to restore the Equilibrium.

Between the 4th and 10th Degrees of North Latitude, and between the Longitudes of Cape Verd, and the Eastermost of the Cape Verd Islands, there is a Track of Sea which seems to be condemned to perpetual Calms, attended with terrible Thunder and Lightnings, and such frequent Rains, that this part of the Sea is called The Rains. Ships in sailing these 6 Degrees have been sometimes detained whole Months, as it is reported.

The Cause of this seems to be, that the Westerly Winds setting in on this Coast, and meeting the general Easterly Winds in this Track, balance each other, and so cause the Calms and the Vapours carried thither by each Wind, meeting and condensing, occasion the almost constant Rains.

The last three Observations shew the Reason of the two following, which Mariners experience in sailing from Europe to India, and in the Guinea Trade. The Difficulty which Ships in going to the Southward, especially in the Months of July and August, find in passing between the Coast of Guinea and the Brazil, notwithstanding the Width of this Sea is more than 500 Leagues: This happens because the S. E. Winds at that Time of the Year, commonly extend some Degrees beyond the ordinary Limits of 4° N. Latitude; and besides, coming so much Southerly, as to be sometimes South, sometimes a Point or two to the West; it then only remains to ply to Windward. And if on the one Side they steer W. S. W. they get a Wind more and more Easterly; but then there is Danger of falling in with the Brazilian Coast, or Shoals; and if they steer E. S. E. they fall into the Neighbourhood of the Coast of Guinea, from whence they cannot depart without running Easterly as far as the Island of St. Thomas, and this is the constant Practice of all the Guinea Ships.

All Ships departing from Guinea for Europe, their direct Course is Northward; but on this Course they cannot go, because the Coast bending nearly East and West, the Land is to the Northward; therefore as the Winds on this Coast are generally between the S. and W. S. W. they are obliged to steer S. S. E. of South, and with these Courses they run off the Shore; but in so doing they always find the Wind more and more contrary, so that when near the Shore they can

lie South; at a great Distance they can make no better than S. E. and afterwards E. S. E. with which Courses they generally fetch the Island of St. Thomas, and Cape Lopez, where finding the Winds to the Eastward of the South, they sail Westerly with it, till coming to the Latitude of four Degrees, South, where they find the S. E. Wind blowing perpetually.

On Account of these general Winds all those that use the West India Trade, even those bound to Virginia, reckon it their best Course to get as soon as they can to the Southward, that so they may be certain of a fair and fresh Gale to run before it to the Westward; and for the same Reason those homeward bound from America, endeavour to gain the Latitude of 30° , where they first find the Wind begin to be variable; though the most ordinary Winds in the North Atlantic Ocean come between the South and West.

Between the Southern Lats. of 10 and 30° in the Indian Ocean, the general Trade Wind about S. E. by S. is found to blow all the Year round in the same Manner as in the like Lats. in the Ethiopic Ocean, and during the six Months, from May to December, these Winds reach to within 2° of the Equator; but during the other six Months, from November to June, a N. W. Wind blows in the Track lying between the 3^{d} and 10^{th} Degrees of Southern Lat. in the Meridian of the North End of Madagascar; and between the 2^{d} and 12^{th} Degrees of South Lat. near the Long. of Sumatra and Java.

In the Track between Sumatra and the African Coast, and from 3° of S. Lat. quite Northward to the Asiatic Coasts, including the Arabian Sea, and the Gulf of Bengal, the Monsoons blow from September to April on the N. E. and from March to October on the S. W. In the former Half-year the Wind is more steady and gentle, and the Weather clearer than in the latter six Months, and the Wind is more strong and steady in the Arabian Sea than in the Gulf of Bengal.

Between the Island of Madagascar and the Coast of Africa, and thence Northward as far as the Equator, there is a Track wherein, from April to October there is a constant fresh S. S. W. Wind which to the Northward changes into the W. S. W. Wind blowing at that Time in the Arabian Sea.

To the Eastward of Sumatra and Malacca, on the North of the Equator, and along the Coasts of Cambodia and China quite thro' the Phillipines as far as Japan, the Monsoons blow Northerly and Southerly; the Northern setting in about October or November, and the Southern about May. These Winds are not quite so certain as those in the Arabian Sea.

Between Sumatra and Java to the West, and New Guinea to the East, the same Northerly and Southerly Winds are observed; but the first Half-year the Monsoons incline to the N. W. and the latter to the S. E. These Winds begin a Month or six Weeks after those in the Chinese Seas set in, and are quite as variable.

These

These contrary Winds do not shift from one Point to its opposite all at once; in some Places the Time of the Change is attended with Calms, in others by variable Winds; and it often happens on the Shores of Coromandel and China, towards the End of the Monsoon, that there are most violent Storms, greatly resembling the Hurricanes in the West Indies, wherein the Wind is so vastly strong, that hardly any Thing can resist its Force.

All Navigation in the Indian Ocean must necessarily be regulated by these Winds; for if Mariners should delay their Voyages till the contrary Monsoon begins, they must either sail back, or go into Harbour, and wait for the returning of the Trade Winds.

Vapours rising from the Sea, and by the Wind carried over low Lands to the Ridges of Mountains, and compelled to mount up with the Stream of the Air to the Tops, where the Water presently precipitates, gleeting down by the Chinks and Cliffs of the Stones, and Part of the Water entering into the Caverns of Hills, and gathering into Basons, which being once filled begin to run over, and form subterraneous Passages through the Earth, breaking out in Springs by the Sides of Hills; several of those meeting together form Rivulets; several of these Rivulets meeting together make a River. This, together with what is incorporated into Vegetables, renders it impossible for all the Water evaporated from the Sea to return to it again.

Hence the Evaporations arising from the Mediterranean are such, that notwithstanding there are 9 capital Rivers, which empty themselves into it, besides smaller ones, there is a constant Current running through the Straits of Gibraltar from the Atlantic Ocean, to make up the Deficiency. R. Mead, M. D. and F. R. S. observes, 1. That some Diseases are properly the Effects of the Influence of the heavenly Bodies. 2. That the most windy Seasons of the Year are about the vernal and autumnal Equinoxes. 3. All the Changes we have enumerated in the Atmosphere do fall out at the same Times when those happen in the Ocean; and, as both the Waters of the Sea and the Air of our Earth or Fluids, are subject in a great Measure to the same Laws of Motion, so that natural Effects of the same Kind are owing to the same Causes. 4. The Alteration made by the Sun and Moon in the Atmosphere must thereby have Influence on the Animal Body. 5. The Elasticity of the Air is of great Moment, and it is reciprocally as the Pressure, so that the incumbent Weight being diminished by the Attraction, the Air underneath will be much expanded; these, and such like Causes, will make the Tides in the Air to be much greater than those of the Ocean; and there is no doubt to be made, but that the same infinite wise Being, who contrived the Flux and Reflux of the Seas, to secure that vast Collection of Waters from Stagnation and Corruption has ordered this Ebb and Flood of the Air of our Atmosphere with the like good Design; that is, to preserve it sweet, and a brisk Temper of this Fluid so necessary to Life, by a continual Circulation. 6. Two contrary Winds blowing towards the same Place, may accumulate the Air there, so as to in-

crease the Height and the Weight of the incumbent Cylinder ; like Manner the Direction of two Winds may be such, as meeting at certain Angles, may keep the Gravity of the Air in a middle State ; but if the Winds blow different Ways from the same Place (which may be occasioned by Thunder and Lightning) the Height and Weight of the Air may be much decreased. 7. The Changes in our Atmosphere at High Water, New and Full Moon, the Equinoxes, &c. must occasion Alterations in all Animal Bodies, for all living Creatures require Air of a determined Gravity to perform Respiration easily, for it is by its Weight that this Fluid insinuates itself into the Cavity of the Breast and Lungs : By a slow Circulation the Secretion of the Spirits is diminished ; and, by the Want of the Force of Elasticity and Gravity, the Juices begin to ferment, change the Union of the Parts, break their Canals, and Diseases follow.

Besides the above Causes, the Atmosphere may be put in Motion by the elastic Vapours forced from the Bowels of the Earth by subterraneous Heats, and condensed by whatever Causes in the Atmosphere. A Mixture of Effluvia of different Qualities in the Air may by Rarefaction, Fermentation, &c. produce Winds and other Effects like those resulting from the Combination of some chymical Liquors ; and that such Things happen, we are assured from the Nature of Thunder, Lightning, and Meteors. From the Eruptions of Volcanoes and Earthquakes in distant Places, Winds may be propagated to remoter Countries. The divided or united Forces of the other Planets, and of the Comets, may variously disturb the Influence of the Sun and Moon, &c. We know that there happen violent Tempests in the upper Regions of the Air, when we below enjoy a Calm, and how many Ridges of Mountains there are on our Globe which interrupt and check the Propagation of the Winds, so that it is no Wonder that the Phænomena we have ascribed to the Action of the Sun and Moon are not always constant and uniform, and that every Effect does not hereupon follow : which, were there no other Powers in Nature able to alter the Influence of, this might in a very regular and uniform Manner be expected from it.

That the Rarefied Air ascends is sufficiently demonstrated by the Aerostatic Globe, or Air Balloon, lately invented ; this is a Globe made of Silk, or other light Stuff, made Air tight with Gum ; which being filled with inflammable, or rarefied Air, will, when let loose, ascend until it comes to that Part of the Atmosphere that is nearly as light as the Air within it, where it will continue some Time.

Some of these Globes have been made so large as to carry up men with them, if we may believe the frequent accounts from France and other Parts.

NOTE. The Swiftnefs of Wind in a great Storm is not more than 50 or 60 Miles an Hour, and a common brisk Gale is about 15 Miles an Hour.

29.5
 49
 221
 116
 1301
 24-20
 1405

O F T I D E S.

THE Tides, or the Flux and Reflux of the Sea, is that regular Motion of the Waters by which they rise and fall at certain equal Intervals of Time.

The Doctrine of Tides remained in Obscurity, till the immortal Sir Isaac Newton explained it by his great Principle of Gravity and Attraction. For having demonstrated that there is a Principle in all Bodies within the Solar System, by which they mutually attract each other, in Proportion to the Squares of their Distances, it follows, that those Parts of the Sea which are immediately under the Moon must be drawn towards it, and consequently whenever the Moon is nearly vertical, the Sea will be raised, which occasions the flowing of the Tide there.

By the Earth's diurnal Rotation from West to East in 24 Hours, the Sun apparently revolves from East to West in the same Time; so by the same Rotation, the Moon apparently revolves from East to West in the Space of 24 Hours 49 Minutes, commonly called a Lunar Day, so as in that Time to return to the Meridian she set out at; and as the Sun apparently moves round the Earth in a Year, so the Moon really moves round it about 29½ Days; consequently, if the Sun and the Moon are both upon the Meridian at any Time, it will be 29 Days and an Half before they are upon the same Meridian again, or in Conjunction, and about Half that Time, viz. 14 Days 18 Hours before they are upon opposite Meridians, or in Opposition. Now, as the Sun attracts the Earth, though much less than the Moon, being at so vast a Distance from it, yet when they are both upon the Meridian, either in Opposition or Conjunction, that is, at Full and Change, their joint Attraction conspires to raise the Tides higher than when they act cross-ways. Hence the Tides are higher than ordinary twice every Month, and are called Spring Tides; but this does not happen till two or three Days after, when the Attractions of the Sun and Moon have been united some Time. But when the Sun and the Moon act cross-ways, or are 90° asunder, the Tides are lessened in Proportion to the Difference of their Powers of Attraction, and produce what we call Neap Tides, which happen soon after the first and last Quarter of the Moon, when the Sun has lessened the Attraction of the Moon for some Time.

The Moon being the principal Cause of raising the Tides, they are always found to follow her, and consequently must always be shifting from West to East as the Moon does, so that it is High Water at any Place when the Moon is upon the Meridian of that Place at Full or Change, it will be about 49 Minutes later on the following Day, 1 Hour 38 Minutes later on the second Day, falling back 49 Minutes every 24 Hours, until the Moon comes to the opposite Meridian; and then it will be High Water again. These Tides regularly

gularly rise and fall twice in the 24 Hours, wherefore by knowing the Time of the Moon's southing at any Place, and the Time of High Water at Full or Change at that Place, we can find the Time of High Water on any other Day at the same Place, by allowing 49 Minutes later for every Day since the Full or Change, or 24 Minutes later for every Tide.

These Tides would be regular from West to East were the whole Earth covered with deep Water, but seeing their Course is obstructed by Land lying in their Way, surrounding Islands, running up winding Rivers, and otherwise affected by Shoals, striking against Capes and Head-lands, they are often forced to take long Circuits and various Directions to come to the Levels; that the Setting of the Tides and Times of High Water are different at different Places.

The Tides rising higher in Bays and Rivers than in the open Sea, is occasioned by its striking against the contracting Banks of Bays and Rivers, accumulate the Water, and cause it to rise higher than in the open Seas.

The Tides are higher than ordinary twice every Year, viz. about the Vernal and Autumnal Equinoxes, and the Neap Tides less, which are occasioned by the Sun's being nearer to the Earth at these Times than at any other Time of the Year, and consequently the Power of Attraction is stronger; for by drawing up the Water when the Sun and Moon are upon the Meridian, to a greater Height than ordinary, the Water 90° distant from the Meridian, must subside in the same Proportion.

The Method generally prescribed for finding the Time of High Water at any Place, is contained in the following Particulars:

To find the Leap-Year.

Divide the given Year by 4, if nothing remains it is Leap Year, but if 1, 2, or 3 remains, they shew that it is so many Years after Bissextile, or Leap Year, as the Remainder is: thus, the Year 1785 divided by 4 gives 446, and the Remainder 1 shews that it is the first after Leap Year.

To find the Golden Number for any Year.

RULE, Add one to the given Year, and divide the Sum by 19, the Remainder will be the Golden Number.

E X A M P L E.

Required the Golden Number of 1784.

By adding one to the present Year, gives 1785, this divided by 19 gives 93 for the Quotient, and the Remainder is 18, the Golden Number for 1784.

To find the Epact for any Year.

RULE. Divide the given Year by 19, the Remainder multiply by 11, and the Product will be the Epact, if it does not exceed 29; but if it does, subtract 30 from it as often as you can, and the Remainder will be the Epact, for it never exceeds 29.

E X A M P L E.

What is the Epact of the Year 1784.

1784 divided by 19 gives 93, and the Remainder 17 multiplied by 11 gives 187; this divided by 30 gives 6, and the Remainder is 7, which is the Epact for 1784.

To find the Moon's Age.

To the Epact add the Day of the Month and the Epact, or Number for the Month, the Sum if it does not exceed 30, is her Age; but if it does, subtract 30 from it as often as you can, and the Remainder is her Age.

The Epact or Number for each Month are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
In com. Yrs.	0	2	0	2	2	4	4	6	7	8	10	10
In Leap Years	0	2	1	3	3	5	5	7	8	9	10	11

E X A M P L E.

Required the Moon's Age the 29th of April, 1784.

To the Epact 7 add the Number for the Month 3, and the Day of the Month 29, the Sum is 39, from which take 30, and the Remainder 9 is the Moon's Age for the given Day.

To find the Moon's Scouting on any Day of her Age.

Since the Moon returns to the Meridian he has left in the Space of 24 Hours, and the Moon in about 24 Hours 49 Minutes, therefore, the Moon leaves the Meridian at the same Time that the Sun

Sun does on any Day, the next Day she will come to the Meridian 49 Minutes after him, falling back about 49 Minutes every Day, whence to find the Time of the Moon's Southing, or coming to the Meridian on any Day, we have this easy Rule :

RULE. Multiply the Day of her Age by 49, and divide the Product by 60, the Quotient is the Hours, and the Remainder the Minutes Afternoon when she souths. Or, which is rather easier, and in many Respects sufficiently exact for the Mariner's Purpose.

Multiply the Moon's Age by 4, and divide the Product by 5, the Quotient is the Hours, and the Remainder multiplied by 12 gives the Minutes after Noon when she is upon the Meridian.

N. B. From the full Moon to the Change she comes to the Meridian, or souths in the Afternoon ; but from the Change to the Full in the Morning.

Required the Moon's Southing, September 1. 1784 ?

The Epact is	7	Moon's Age	16	or thus	16
Number for the Month is	8	Multiplied by	49		4
Day of the Month	1				
			6.0)784		5)64
Moon's Age	16				
		—	Moon's Southing 13.4 M's. South. 12,48		

Hence it appears, that the Moon comes to the South at 4 M. after one next Morning, and subtracting 12 H. 24 M. from it, leaves 40 M. the Time of southing in the Afternoon.

To find the Time of High Water on any Time of the Moon's Age at any Place.

From the Observations of many Persons, there have been collected the Times when it is High Water on the Days of the New and Full Moon on most of the Sea Coasts of Europe, and at several other Places, and these Times are commonly put in a Table against the Names of the Places in an alphabetical Order, for which Reason it is called the Tide Table ; but in this Treatise the Times of High Water at Full and Change are set down before the Latitude and Longitude of each Place in the Table of Latitudes and Longitudes of Places.

RULE. To the Time of the Moon's southing on the given Day, add the Time of High Water at Full and Change at the given Place, taken from the Table ; the Sum is the Hour, past Noon on the given Day, when it is High Water at that Place.

And if this Hour exceeds 12, subtract 12 Hours 24 Minutes from it, and the Remainder shews the Time of High Water after Midnight ; but if it exceeds 24, subtract 24 H. 49 M. from it, and the Remainder shew

shews the Time of High Water the next Day, which being reduced back to the given Day, by allowing 12 Hours 24 Minutes for a Tide, gives the Time of High Water the given Day.

E X A M P L E I.

At what Time will it be High Water at London, Sept. 1, 1784?

To the Time of the Moon's southing that Day, 13 Hours 4 Minutes, add 3 Hours, the Time answering to London in the Table, and you have 16 Hours, 4 Minutes, the Time of High Water at London after Noon; and subtracting 12 H. 24 M. from it, leaves 3 H. 40 M. the Time of High Water in the Afternoon on the given Day. Again, take 24 M. the Difference of a Tide from it, and the Remainder 3 H. 16 M. is the Time of High Water in the Morning.

What Time will it be High Water at London, May the 28th, 1784?

19)1784(93

171

74

57

17

11

30)187(6

180

The Epact

7

Num. of Month

3

being Leap Year

Day of Month

28

30)38(1

30

or thus 49

8

Moon's Age

8

60)392(6.32

4

360

H. M.

southing

5)32(6h. 24 m. 32

30

2=24

H. M.

Moon's Southing

6 32

Time at London

3 00

High Water

9 32

Required the Time of High Water at Dover, October 12, 1790?

19)1790(94

171

80

76

4

11

44

30

14 Epact

12 Day of Month

8 Num. Month

34

30

4 Moon's Age

49

6.0)19.6

3 16 Southings

10 30 at Dover

14 46

12 24 $\frac{1}{2}$ a Tide.

2 22 High Water

T

Note.

Note. The Epact advances 11 every Year to 30, because the Solar Year is 11 Days longer than the Lunar Year; and as the Epact increases, it shews the Moon's Age at the Beginning of the Year. It is here supposed, that at the End of 19 Years, the Sun and Moon make all the variety of Situations they possibly can with one another, and thence begin and go over the same again. The Golden Number at the Birth of Christ was 1, which is the Reason that 1 is added to the given Year to find the Golden Number.

The Epact is the Moon's Age at the Beginning of the Year, or rather March 1st, and the Numbers of the Months are for regulating the Lunations to an Equality of about 30 Days, the Day of the Month being added to it gives the Moon's Age.

This is the Method of finding the Time of High Water inserted in common Books of Navigation, which, at Times, will give the Moon's Age whole Days, and the Time of her Southing, and of High Water, Hours wide of the Truth; and even if the Moon's southing be exactly found, yet the Tides may differ less or more from the computed Time; for the Floods do not always happen at the same Distance of Time from each other, but at different Distances, according to the Times of the Moon's Age, and her Aspect with Respect to the Sun, or as the Waters are acted upon by the Sum or Difference of the attractive Forces of the Sun and Moon, and also on Account of Winds and Storms, even when out of Hearing, which greatly affected the Tides; the real Time of High Water at any Place will often differ from the computed Times; therefore Pilots and all concerned, would do well to use the following Method, which will, in general, give the Time of High Water within Half an Hour of the Truth, when the Tides are not greatly influenced by the Wind.

The Use of the following Tables for finding the Moon's Age, and Time of High Water at any Place.

RULE. Find the Moon's Age in the following Table, shewing the mean Times of her Changes, by reckoning the Number of Days since her last Change; and only observing, that the Day on which you find her Age is to be excluded; that is, you are only to count the Days that are compleatly elapsed since her last Change; and against her Age in the second Table you will find Hours and Minutes, which being added to the Time of High Water, at Full and Change at the given Place, are set down in the Table of the Latitudes and Longitudes of these Places, will give the Time of High Water there on the given Day.

E X A M P L E

E X A M P L E I.

Required the Time it will be High Water at London, Sept. 1, 1784.

In the Table of Changes, opposite to 1784, and under August, I find that it was New Moon the 16th, at 3 in the Morning, and by reckoning forward to September the 1st, find that it is 16 Days since her last Change, then, in the Table of Times against 16, her Age, stand 0 H. 56 M. to which I add 3 Hours (the Time of High Water on Full and Change Days at London) gives 3 H. 56 M. so that it is High Water 56 Minutes after three in the Morning at London, on the given Day, differing from the other Method 16 Minutes.

E X A M P L E II.

What Time will it be High Water at London, June the 1st, 1786?

Opposite to 1786, and under May, in the Table of Changes, I find it was New Moon the 27th Day, at 6 in the Afternoon, and, reckoning forward to June the 1st, find that ~~she~~ it is almost 5 Days old. In the Table of Times, against her Age, 5 Days, stand 3 Hours, 2 Minutes, this added to 3 Hours, is 6 Hours, 2 Minutes, the Time of High Water at London, in the Evening, on June the 1st, 1786.

E X A M P L E II.

At what Time will it be high Water at London, May 28th, 1784?

Against 1784, and under May, I find it is New-Moon the 19th, and reckoning forward to the 28th, find there are 8 Days elapsed since last Change; then against 8, under Moon's Age, stands 5 H. 10 M. the Time of High Water in the Afternoon, and 3 Hours being added to it, gives 8 H. 12 M. the Time of High Water in the Afternoon at London, on the given Day, differing from the other Method 1 H. 20 M.

E X A M P L E IV.

Required the Time of High Water at Dover, Oct. 12, 1790?

Against 1790, and under October, I find it is New-Moon the 8th, at 10 in the Morning, and counting forward to the 12th, find that the Moon is nearly 4 Days old; then against 4, her Age, stands 2 H. 28 M. to which add 10 H. 30 M. the Time making High Water at Full and Change at Dover, gives 12 H. 58 M. the Time of High Water after Noon, from which take 12 H. 24 M. or Half a Tide, the Remainder 34 M. is the Time of High Water at Dover, in the Afternoon on the given Day, differing from the other Method 1 H. 48 M.

A T A B L E

Shewing the Times of all the mean Changes of the Moon to the nearest Hour, from the Beginning of the Year 1778, till the End of the Year 1799, according to the new Stile. And also a Table of the Shifting of the Tide, by which will appear the Error in reckoning High Water to be $\frac{3}{4}$ of an Hour later every Day after Full and Change.

T A B L E I.

T A B L E II.

Mean Changes							Moon's Age.	Times Anf.	
Year	Jan. D. H.	Feb. D. H.	March. D. H.	April D. H.	May D. H.	June D. H.		High Water later than Full and Change each Day.	
1778	28. 3m.	26. 4 a	28. 3m	6. 6 a	26. 6m	24. 7 a		Afternoon.	
1779	17. 0 a	16. 1m	17. 2m	6. 3m	15. 3 a	14. 4m.			
1780	6. 9 a	5. 10m	5. 11 a	4. 11m	3. 12a	2. 0 a			
1781	24. 6 a	25. 7m	24. 5m	23. 9m	21. 9 a	21. 10m	Days		
1782	13. 7 a	12. 4 a	14. 5m	12. 6a	12. 6m	11. 1m	1		
1783	3. 0 a	2. 1m	3. 2 a	2. 2m	1. 3 a	29. 4 a	2		
1784	22. 9m	20. 10 a	21. 11 a	19. 12 a	19. 0 a	18. 1m	3		
1785	10. 6 a	9. 7m	10. 8 a	9. 9m	8. 10 a	7. 10m	4		
1786	29. 4 a	28. 5m	29. 5 a	28. 6m	27. 6 a	26. 7m	5		
1787	18. 12 a	17. 1 a	12. 2m	17. 3 a	17. 3m	15. 4 a	6		
1788	8. 9m	6. 0 a	7. 11m	5. 12 a	5. 1 a	4. 1m	7		
1789	26. 7m	24. 8 a	26. 9m	24. 10 a	24. 10m	22. 11 a	8		
1790	15. 4 a	14. 3m	15. 5 a	14. 6m	13. 6 a	12. 7m	9		
1791	4. 12 a	3. 1 a	5. 2m	3. 3 a	3. 4m	1. 4 a	10		
1792	13. 10 a	22. 11m	22. 12 a	21. 1 a	21. 1m	19. 2 a	11		
1793	12. 7m	10. 8 a	12. 9m	10. 10 a	10. 10a	8. 11 a	12		
1794	1. 4 a		1. 6 a	29. 7 a	29. 7m	27. 8 a	13		
1795	31. 5m		31. 6m	29. 7 a	29. 7m	27. 8 a	14		
1796	20. 1 a	19. 2m	20. 3 a	19. 4m	18. 4m	17. 5m	15		
1797	9. 10 a	8. 11m	8. 12 a	7. 0 a	7. 1m	5. 1 a		After Change the Moon comes to the Meridian in the Afternoon.	
1798	21. 7 a	26. 8m	27. 9 a	26. 10m	25. 10 a	24. 11m			
1799	17. 4m	5. 5 a	17. 6m	15. 7 a	15. 7m	13. 8 a			
1799	6. 1 a	5. 2m	6. 3 a	5. 4m	4. 5 a	3. 5m			

To find the Time of High Water.

First, find the Moon's Age in the first Table, by counting the Days since her last Change, and against her Age, in the second Table, find Hours and Minutes, to which add the Time making High Water at Full and Change at that Place, which gives the Time of High Water any Day there.

A Table

A T A B L E

Shewing the Times of all the mean Changes of the Moon to the nearest Hour, from the Beginning of the Year 1778, till the End of the Year 1799, according to the New Stile. And also a Table of the Shifting of the Tide, by which will appear the Error in reckoning High Water to be $\frac{3}{4}$ of an Hour later every Day after Full and Change.

T A B L E I.

T A B L E II.

Mean Changes.							Moon's Age. Times Answ	
Year.	July	Aug.	Sept.	October.	Novem.	Decem.		
	D. H.	D. H.	D. H.	D. H.	D. H.	D. H.		High Water later after Full and Change each Day.
1778	24. 8m	22. 9	21. 9m	20. 10m	19. 11m	18. 12		
1779	13. 5 a	12. 6m	10. 6 a	10. 7m	8. 8 a	8. 9 m		
1780	2. 1m 31. 2 a	30. 3m	28. 3 a	28. 4m	26. 5 a	26. 6m		
1781	20. 11	19. 0 a	17. 12	17. 1 a	16. 2m	15. 3 a	Days.	H. M.
1782	10. 8m	9. 2m	7. 2 a	6. 10 a	5. 11m	4. 12 a	16	0 56
1783	29. 5m	27. 6 a	26. 6m	25. 7 a	24. 8m	23. 9 a	17	1 24
1784	17. 2 a	16. 3	14. 3 a	14. 4m	12. 5 a	12. 6m	18	2 8
1785	6. 11 a	5. 0 a	4. 1m	3. 1 a	2. 2m	1. 3 a	19	2 40
1786	15. 8 a	24. 9m	22. 9 a	22. 10m	20. 11 a	20. 0 a	20	3 14
1787	15. 5m	13. 6 a	12. 6m	11. 7 a	20. 8m	9. 9 a	21	3 52
1788	3. 2 a	2. 3m 31. 4 a	30. 4m	29. 5 a	28. 6m	27. 7 a	22	4 36
1789	22. 0 a	21. 1m	19. 1 a	19. 2m	17. 3 a	17. 4m	23	5 22
1790	11. 8 a	10. 9m	8. 9 a	8. 10m	6. 11 a	6. 0 a	24	6 16
1791	30. 6 a	29. 7m	27. 7 a	27. 8m	25. 9 a	25. 10m	25	7 18
1792	19. 3m	17. 4 a	16. 4m	15. 5 a	14. 6m	13. 7 a	26	8 22
1793	8. 0 a	7. 1m	5. 1 a	5. 2m	3. 3 a	3. 4m	27	9 26
1794	27. 9m	25. 10 a	24. 10m	23. 11 a	22. 0 a	22. 1m	28	10 30
1795	16. 6 a	15. 7m	13. 7 a	13. 8m	11. 9 a	11. 10m	29	11 32
1796	5. 2	3. 3 a	2. 4m	1. 4 a 31. 5m	29. 6 a	29. 7m	29 $\frac{1}{2}$	12 12
1797	22. 12 a	22. 1 a	21. 1m	20. 2 a	19. 3m	18. 4	After Full Moon she comes to the Meridian after Midnight.	
1798	13. 9m	11. 10 a	10. 10m	9. 11 a	8. 0 a	8. 1m		
1799	2. 6 a	1. 7m 30. 8 a	29. 8m	28. 9 a	27. 10m	26. 11		

Note, *a* stands for Afternoon, and *m* for Morning.

In some Places it is High Water on the Shore while the Tide continues to flow in the Stream or Offing. If it runs 3 Hours longer it is called the Tide and Half Tide; an Hour and an Half makes Tide and Quarter Tide; Three Quarters of an Hour makes Tide and Half Quarter Tide, &c.

A Table

TABLE for the ready finding the Day of the Month the **NEW MOON** will fall on till the Year 1900, and consequently the **MOON'S AGE** for any Day, by knowing the **GOLDEN NUMBER**, according to the Method commonly used in finding the Moon's Age, &c.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Gn. N.	N M	N M	N M	N M	N M	N M	N M	N M	N M	N M	N M	N M
1	29	28	29	28	27	26	25	24	22	22	20	20
2	18	17	19	17	17	16	15	13	12	11	10	9
3	8	6	7	5	5	3	3	2	1:30	29	28	27
4	26	25	27	25	25	23	22	20	19	18	17	17
5	15	14	16	15	14	13	12	10	8	8	6	6
6	4	3	5	3	3	1	1:30	29	27	27	25	25
7	23	22	22	21	20	19	18	17	16	15	14	13
8	12	10	12	10	10	8	8	6	5	4	3	3
9	1	—	1	29	29	27	27	25	24	23	22	21
10	20	18	20	19	18	17	16	15	13	13	11	11
11	9	8	8	7	6	5	4	4	2	1	29	29
12	27	26	27	26	25	24	23	22	20	20	18	18
13	17	15	17	15	15	13	13	11	10	9	8	7
14	6	4	6	5	4	3	2	1:30	29	28	27	26
15	25	23	24	22	22	20	20	19	17	17	15	15
16	13	12	13	12	11	10	9	8	6	6	4	4
17	3	1	3	1	1:30	29	28	27	25	25	23	23
18	22	20	22	20	20	18	18	16	15	14	13	12
19	11	9	10	8	8	6	6	5	3	2	1	1:30

The Use of the foregoing Table.

First. To find the Moon's Age any Day, you must first find the Golden Number for the Year, in the first Column, marked Gn. No. and on the same Line, under the Month, you will find the Day of the Month the Moon changes on, or New Moon, the Day after is the first Day of the Moon's Age; and then it is no more than counting the Number of Days, either before or after the Change, to the Day required.

NOTE. Set the Golden Number at the Top in Pencil, and that will serve for the whole Year.

In like Manner may the Time of High Water be found at any other Place. Whoever will compare these Examples with the Methods used in other Books of this Kind, will find a considerable Difference, as they frequently give the Moon's Age several Days, and of High Water, Hours wide of the Truth; indeed, on Account of the Irregularities in the Moon's Motion, the Times of her Change may differ Half a Day from the Truth, and the Time of High Water 30 Minutes, but seldom more, if the Sea is not greatly influenced by the Wind.

The Tides do not always answer to the same Distance of the Moon from the Meridian at the same Places, but are variously affected by the Action of the Sun, which brings them on sooner when the Moon is in her first and third Quarters; and keeps them back later when she is in her second and fourth Quarters: because, in the former Case, the Tides raised by the Sun alone would be earlier than the Tide raised by the Moon; and in the latter Case later,* as may be seen in the Table of the Shifting of the Tides.

As the Nautical Almanack is become now of general Use in long Voyages, the Time of High Water at any Part of the World may be readily found, if the Time making High Water at Full and Change be known; for in the sixth Page of each Month is given the Time of the Moon's Passage over the Meridian of Greenwich every Day: This Time may be reduced to the Meridian of any other Place, by allowing 1 Hour for every 15 Degrees of Longitude. To this Time add the Time making High Water there, on Full and Change Days, gives the Time of High Water nearly on that Day, if the Sum be less than 12 Hours; but if above, subtract 12 Hours 24 Minutes, or 24 Hours 49 Minutes from it; observing, that the Days in this Almanack begin 12 Hours later than the common Days.

* See Ferguson's Astronomy.

Among Pilots it is customary to reckon the Time of Flood, or High Water, by the Point of the Compass the Moon bears on at that Time, allowing three Quarters of an Hour for each Point. Thus, in Places where it is Flood at Noon on the Days of Full and Change, the Tide is said to flow North and South, or at 12 o' Clock. In Places where the Moon bears 1, 2, 3, 4, or more Points to the East or West of the Meridian, when it is High Water on the same Days, the Tide is said to flow on such a Point; so if the Moon bears S. E. at Flood, it is said to flow S. E. and N. W. or 3 Hours before the Meridian, that is, 9 o' Clock; if she bears S. W. it flows S. W. and N. E. or at 3 Hours after the Meridian; and in like Manner for other Points of the Moon's bearing, as in the following Table:

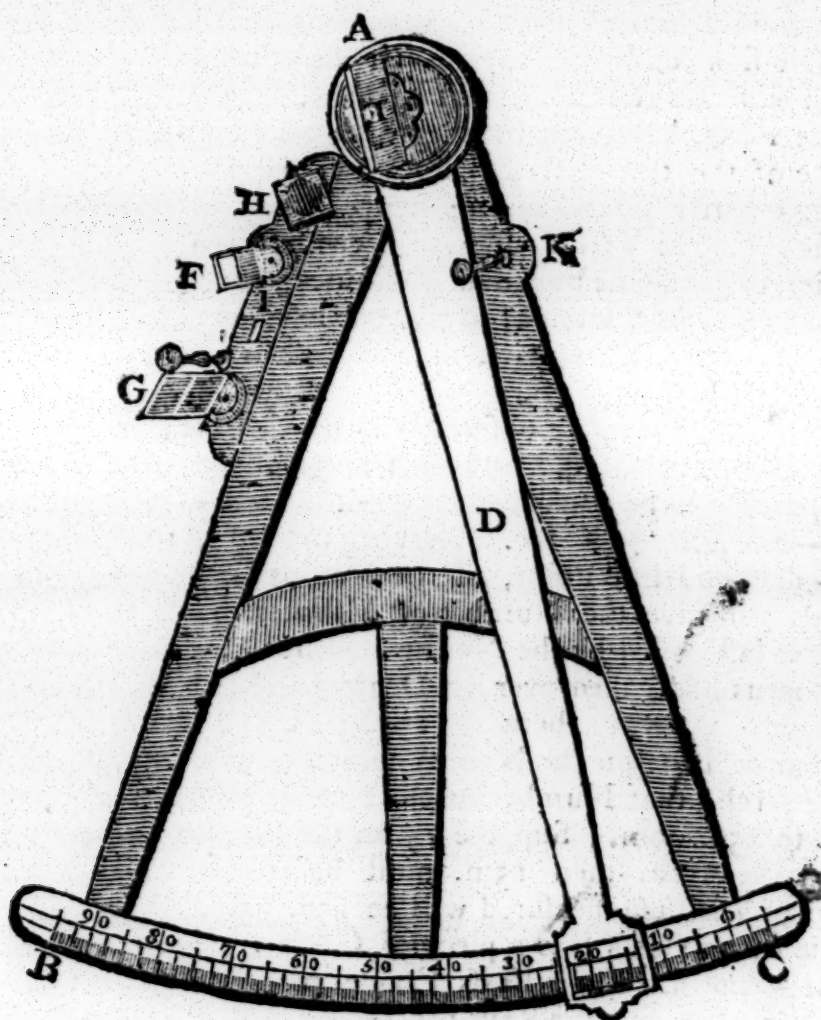
A TABLE of the Bearings of the MOON at the Time of High Water, with the Time of those Bearings at the following Places:

When the Moon bears as follows		H.	
N. and	S.	12	{ Isle of Alderney, Gibraltar, Southampton, Beachy, Sheerness, a Sand called Kentish Knock, a Sand called the Swin, at the Mouth of the Thames.
N. by E.	S. by W.	$0\frac{3}{4}$	{ or 45 Minutes past 12, Rochester, Flushing, Malden, Nore.
N. N. E.	S. S. W.	$1\frac{1}{2}$	{ or 30 Minutes past 1, Bell Isle, Tinmouth, Gravesend, Holyhead.
N. E. by N.	S. W. by S.	$2\frac{1}{4}$	{ or 15 Minutes past 2, Berwick, Lisbon, St. Andrew's, Couquet.
N. E.	S. W.	3	{ Whitby, London, Amsterdam, Bourdeaux, Bay of Biscay.
N. E. by E.	S. W. by W.	$3\frac{1}{4}$	{ Brest, Huntcliff, Isle of Bas, at the Maes Scarborough.
E. N. E.	W. S. W.	$4\frac{1}{2}$	{ In Bresound, Ushant, Scilly, Cork, C. Clear
E. by N.	W. by S.	$5\frac{1}{4}$	{ Humber Mouth, at the Spurn, Torbay, Start Point.
E.	W.	6	{ Hull, Wells, Weymouth, Plymouth, Ramhead.
E. by S.	W. by N.	$6\frac{3}{4}$	{ Bristol, Portland Road, Lynn, Foulness, Foy
E. S. E.	W. N. W.	$7\frac{1}{2}$	{ Lizard, Land's End, Falmouth, Penryn, C. Barfleur.
S. E. by E.	N. W. by W.	$8\frac{1}{4}$	{ Eddystone, Yarmouth, Needles, Fly, Dublin, I. of Ely.
S. E.	N. W.	9	{ Isle of Man, Isle of Wight, E. End, Caskets, Caen, St. Helen's.
S. E. by S.	N. W. by N.	$9\frac{3}{4}$	{ N. Foreland, Dungeness, Dunnose, Shoreham
S. S. E.	N. N. W.	$10\frac{1}{2}$	{ Downs, Deal, Dover, S. Foreland.
S. by E.	N. by W.	$11\frac{1}{4}$	{ Margate, Harwich, Rose, Pool, Portsmouth, Spithead, Calais.
S.	N.	12	{ Dunkirk, Embden, R. Elbe, Coast of Flanders, Ostend.

Note. The Current in the Downs generally runs $7\frac{1}{4}$ Hours to the North; and $5\frac{1}{4}$ Hours to the Southward; at Dover the Tide from the Channel runs Northward $7\frac{1}{4}$ Hours; and from the North 5 H. 10 M. at the Full and Change of the Moon. The Tides set in the Downs N. N. E. and S. S. W. Hourly. It is High Water at London 46 Minutes after Two at Full and Change by the Shore.

The Description and Use of HADLEY'S OCTANT, commonly called HADLEY'S QUADRANT.

THE Principles of this admirable Instrument have been so well demonstrated by other Hands, that a Repetition of it here seems to me unnecessary, especially to the practical Mariner, I shall therefore content myself with a short Description thereof.



The principal Parts of this Instrument are,

The Index D
 The Index Glass E
 The Horizon Glasses G and F
 The dark Glasses, or Screens H
 The Sight Vanes K and G

The graduated Arch B C contains only 45 Degrees, or is the Eight Part of a Circle, but is to be esteemed as 90°, and so divided, because by the double Reflection the Angle is doubled.

U

The

The Divisions run 0, 10, 20, &c. to 90 as in the Figure, each Degree is divided in 3 Parts of 20 Minutes each, which by the Help of the Vernier, or Divisions on the Index, is again subdivided into Minutes of a Degree, thus,

The Index D is a flat Bar moveable on the Centre of the Instrument, that Part of the Index that slides over the graduated Arch having the first and last Divisions thereon corresponding to those on the Arch, is called the Vernier or Nonius, and which divides every Sub-division on the Arch in Minutes, thus, 7 Divisions on the Nonius being divided into 20 Parts, it is evident the Difference between the first Divisions on the Arch and on the Nonius is $\frac{1}{20}$ of one of the Subdivisions on the Arch, or 1 Minute, because 7° there is divided into 21 Parts, being one in 20 greater than on the Arch. The Difference of the two first Divisions will be $2'$, and the Difference of the three First, 3, and so on; hence it will arise, that in whatever Divisions on the Vernier and Arch cut one another the nearest, the Vernier will indicate how many Minutes above the next Sub-division according as it is numbered to right or left thereof. On the Bottom of the Index against the Back of the Arch is a Screw made to fix fast the Index when required.

The Arch, as before observed, is divided into 90 Degrees, numbered 0, 10, 20, 30, &c. and each Degree into 3 Parts, each 20 Minutes, and is to be read thus: 1d.—1d. 20m.—1d. 40m.—2d.—2d. 20m.—2d. 40m.—3d. &c. observing to read to the Division that the 0, or diamond-like Point, of the Nonius last passed over; then the Nonius will give the Number of Minutes more, to be added to the Division last passed by the Nonius. Thus, suppose the 0, or Δ of the Nonius has passed over 15 Degrees and two Parts, or 15d. 40m. and stands somewhere between 15d. 40m. and 16d. then observe what Division or Line on the Nonius coincides with any Division or Line on the Arch, that Number on the Nonius will be the Minutes to be added to 15d. 40m. Suppose 15 on the Nonius touches some Division on the Arch, then 15m. must be added to 15d. 40m. and the Angle or Altitude measured will be 15d. 55m.

The Index Glass E is a piece of Glass truly ground, silvered on the Back and fixed in a Brass Frame, perpendicularly to the Index, its Use is to receive the Rays proceeding from any Object, and reflect them to the Horizon Glasses F and G; at the Back of the Brass Frame of this Glass are two screws, serving to adjust the Frame perpendicularly to the Index.

The Horizon Glasses F and G are smaller pieces of ground glass, one part of which is silvered and the other part open or unsilvered, in order to look at an Object through it; these are set in Frames and placed perpendicularly on the Limb at G and F; their Use is to receive the Rays of any Object reflected from the Index Glass, and again to reflect those Rays to the Eye through the Holes of the Sight Vanes K and G.

To

To adjust the Quadrant.

FIRST, The Index Glas must be perpendicular to the Plane of the Quadrant, which if not, you may thus discover; hold the Plane of the Quadrant in an Horizontal Position, with the Index Glas near the Eye, look right down the Quadrant in such a Manner as to see the Arch of the Quadrant direct, and at the same Time reflected by the Index Glas; then if the Arch seen direct together with its reflected Image appear to be in one Line, the Index Glas is truly adjusted, if not it must be rectified by Means of the Screws placed at the Back of the Index Glas; it is easy to discover which way the Inclination is by pressing the Index Glas with your Thumb while you observe the Arch.

Secondly, The Axis of the Horizon Glas must be parallel to the Axis of the Index Glas, if not the Error is easily discovered and rectified in the Fore Horizon Glas when the Index Glas is adjusted, thus, bring O on the Nonius nearly to O on the graduated Arch, and look directly through the sight Vane at the Moon or any bright Star, so as to see the reflected Image in the Horizontal Glas, and the Object at the same Time through the unsilvered Part, then move the Index backwards and forwards slowly, and observe if both Images coincide or pass behind one another, which if they do, the Axis of both are parallel, which if not you should nicely adjust by the two Screws placed on the Top Block of the Horizon Glas.

If a small Piece of coloured Glas set in Brass be made to turn round to the Sight Vane occasionally to guard the Eye, and the Screws turned back, the same Correction may be made by using the Sun instead of the Moon or Star.

To take the Altitude of the Sun by the Fore Observation.

The Sun's Image at any Time when not much obscured by Clouds, may be seen as reflected from the unsilvered Part of the Horizon Glas, by looking through the Hole in the Sight Vane; having put the Screens down to guard the Eye, hold the Instrument vertical, and turning towards the Sun, direct the Sight to that part of the Horizon beneath the Sun, and moving the Index you may bring down the red Image of the Sun towards the Horizon; if the Sun's Image should be faint you may turn back the Screens, and you cannot miss it.

Having brought down the Sun's Image near the Horizon, swing the Quadrant backwards and forwards, making your Eye the Centre of Motion, and keep moving the Index at the same Time till the Sun's lower Edge just touches the Horizon, and you will have the Apparent Altitude of the Sun's lower Limb upon the Arch of the Quadrant at that Instant. But this Altitude is greatest at Twelve o'Clock, when the Sun is on the Meridian, from which the Latitude is determined;

terminated; much Time will be saved if you have a good Watch well regulated to tell you within a Minute or two when to begin your Observation, but this Apparent Altitude requires the four following Corrections:

First, The Index Error, if any, to be added or subtracted.

Secondly, The Dip of the Horizon.

Thirdly, The Sun's Semi-diameter and Refraction.

These four Corrections are necessary to find the true Altitude of the Sun's Centre nearly, the Correction for the Sun's Parallax being so small, that it may be always neglected in determining the Latitude.

The Back Observation is managed the same as the Fore Observation, only your Back must be turned towards the Sun, and the Screens shifted to the back Horizon Glass, remembering to subtract the Sun's Semi-diameter (if the apparent lower Limb be taken) and add the Dip, subtracting the Effect of Refraction, and you will have the Altitude of the Sun's Centre.

The Correction for the Index Error is thus, turn down the small Knob of Brass, placed on the Limb, to hinder the Index from going off the Arch, as it may be in the Way. This Correction may be accurately estimated by taking the Diameter of the Sun, Moon, or any Object before and behind O on the Arch, that is, bring the upper Limb of the Object to coincide with the Lower, and note the Angle, then take it on the extra Arch, as it is called, that is, bring the lower Limb to coincide with the Upper, and note the Angle, half the Difference of these two Angles will be the true Correction of the Index Error.

E X A M P L E.

Suppose the Sun's Diameter measures 36 on the Arch, and 28 in the extra Arch. The Difference is 8' half which is the Error to be subtracted, because the Diameter measures more on the Arch, or gives the Sun's Diameter too much, but had the extra Arch given the greater Angle, the Error would have been additive.

To take the Altitude of the Moon.

The Moon's Altitude may be taken either by the Fore or Back Observation exactly in the same Manner as the Sun's Altitude, only here you must bring the Edge of the Moon into contact with the Horizon, which is round and will defend whether that be the upper or under Edge: the Corrections to be applied to the observed Altitude are as follows:

First, The Index Error as before directed.

Secondly,

Secondly, The Dip to be subtracted in the Fore Observation, and to be added in the Back Observation.

Thirdly, Semi-diameter to be found in the Nautical Ephemeris for every Noon and Midnight at Greenwich; if very great Accuracy is required this Semi-diameter must be corrected for the intermediate Time.

Fourthly, Parallax and Refraction. The Moon's Horizontal Parallax for every Noon and Midnight at Greenwich is to be found in the Nautical Ephemeris. When Nicety is required this must be corrected for all the intermediate Times; then with the apparent Altitude and Horizontal Parallax enter Table II. and take out the Correction, which add to the Apparent Altitude, and that will give the true Altitude of the Moon's Centre.

To take the Altitude of a Star by the Fore Observation.

Set the Index at O, and holding the Plane of the Octant vertical direct the Sight to the Star, and at the same Time look for the reflected Image of the Star in the silvered Part of the Horizon Glass; move the Index a little, which will separate the reflected Image from the direct Image, the former will be easily distinguished from the latter by its Motion, when you stir the Index; continue to advance the Index, and at the same Time follow the reflected Image of the Star with your Eye, directing the Sight lower and lower, and changing the Position of the Quadrant or Octant, as the Image of the Star descends, till you have brought it down to the Horizon, the Index will then shew the observed Altitude of the Star. The Corrections to be applied to the observed Altitude of the Star are, first, the Index Error; Secondly, the Dip, these two give the Apparent Altitude; Thirdly, the Refraction, which gives the true Altitude; the fixed Stars have neither Semi-diameter nor Parallax worth Notice.

In taking the Altitude of a Star, or the Moon, by Night, always get as near the Water as possible, in easy Weather a Grating may be slung over the Ship's Side, and an Observer sit upon it to take the Altitudes; the same may be done to take the Altitude of the Sun in an hazy Horizon, for the nearer the Eye is to the Surface of the Water, the nearer the true Horizon will be to the Eye.

Advice to Seamen in the Choice of their Quadrants or Sextants.

The Joints of the Frame must be close without the least opening or looseness, and the Ivory on the Arch and Nonius inlaid and fixed, so as not to rise at the Ends, nor above the Plane of the Instrument; all the Divisions on the Arch and Nonius must be exceeding
fine

fine and straight, so that when the Index or Nonius is set to any Division on the Arch, the Divisions on the Line that coincides may appear distinct, for only the first and last Line on the Nonius will coincide with other Lines upon the Arch, if the Quadrant is well divided; likewise try in different Parts of the Arch, if the Nonius, or Index Plate cuts regularly in order with those on the Arch, if they do not the Divisions are bad, and the Quadrant ought to be rejected.

Again, Look into the great Speculum or Index Glass slant-ways, holding it about ten or twelve Inches from the Eye, and observe the Image of some distant Object; if the Image appears clear and distinct in every Part of the Glass, the Speculum is good; but if it appears notched, or drawn with small Lines, the Glass is veiny, and must be rejected; if more Images than one of the same Object are seen, it shews that the two Surfaces are not ground Parallel; the other Speculum may be examined in the same Manner.

Observe the Sun or a Candle through the dark Glasses severally, holding the Glass about eight or ten Inches from the Eye; if they are veiny the Object will appear notched at the Edges, but if clear and well defined, the Glasses are good.

Most People prefer black Ebony, on Account of its Weight, but I have found by Experience, that good Mahogany takes the Glue, and stands the Heat better.

Quadrants, like Watches, may appear well to the Eye, and yet be good for little; it is therefore much better to give two Guineas and an Half, or three Guineas, for a good one, that will last a Man for Life, than purchase those wretched Instruments made up at a low Price, which cannot be depended on.

Of the Dip and Refraction.

The Rays of Light in passing through the Atmosphere are bent out of their straight Course into a curve Line; and hence it happens that all the Heavenly Bodies, except when they are in the Zenith, appear higher than they ought to do, and so much the more the nearer they are to the Horizon. This apparent Elevation of the Heavenly Bodies above their true Height is called the Refraction of Objects; and the Quantity or Effect of it, according to the different Altitudes of Objects, has been carefully observed by eminent Astronomers, and must always be subtracted from the apparent Altitude, but added to the apparent Zenith Distance of an Object with whatever Instrument the Observation is made, in order to obtain its true Altitude or Zenith Distance.

That the Correction of observed Altitudes of Objects both on Account of the Dip of the Horizon and the Refraction of their Light, may appear at one View, they are both exhibited together in the following Table.

A Table

Elevation of the Eye above Sea in Feet.		Dip of the Hor. of the Sea.		A Table of the Refraction of the Heavenly Bodies, to be subtracted from the observed Altitude.																				
				App. Alt.		Refrac.		App. Alt.		Refrac.		App. Alt.		Ref.		App. Alt.		Refr.		App. Alt.		Ref.		
				°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	
1	0	57		0	33	0		4	50	10	11	10	30	5	0	26	0	1	56	59	0	0	34	
2	1	21		5	32	10		5	0	9	54	10	45	4	53	27		1	51	60			33	
3	1	39		10	31	22		5	10	9	38	11	0	4	47	23		1	47	61			32	
4	1	55		15	30	35		5	20	9	23	11	15	4	40	29		1	42	62			30	
5	2	08		20	29	50		5	30	9	8	11	30	4	34	30		1	38	63			29	
6	2	20		30	28	22		5	40	8	54	11	45	4	29	31		1	35	64			28	
7	2	31		32	28	5		5	50	8	41	12	0	4	23	32		1	31	65			26	
8	2	42		36	27	30		6	0	8	28	12	20	4	16	33		1	28	66			25	
9	2	52		40	27	0		6	10	8	15	12	40	4	9	34		1	24	67			24	
10	3	1		50	25	42		6	20	8	3	13	0	4	3	35		1	21	68			23	
12	3	18		1	0	24	29	6	30	7	51	13	20	3	57	36		1	18	69			22	
14	3	34		1	10	23	20	6	40	7	40	13	40	3	51	37		1	16	70			21	
16	3	49		1	20	22	15	6	50	7	30	14	0	3	45	38		1	13	71			20	
18	4	3		1	30	21	15	7	0	7	20	14	20	3	40	39		1	10	72			18	
20	4	16		1	40	20	18	7	10	7	11	14	40	3	35	40		1	8	73			17	
22	4	28		1	50	19	25	7	20	7	2	15	0	3	30	41		1	5	74			16	
24	4	40		2	0	18	35	7	30	6	53	15	30	3	24	42		1	3	75			15	
26	4	52		2	10	17	48	7	40	6	45	16	0	3	17	43		1	1	76			14	
28	5	3		2	20	17	4	7	50	6	37	16	30	3	10	44			59	77			13	
30	5	14		2	30	16	24	8	0	6	29	17	0	3	4	45			57	78			12	
35	5	39		2	40	15	45	8	10	6	22	17	30	2	59	46			55	79			11	
40	6	22		2	50	15	9	8	20	6	15	18	0	2	51	47			53	80			10	
45	6	24		3	0	14	36	8	30	6	8	18	30	2	49	48			51	81			9	
50	6	44		3	10	14	4	8	40	6	1	19	0	2	44	49			49	82			8	
60	7	23		3	20	13	34	8	50	5	55	19	30	2	39	50			48	83			7	
70	7	59		3	30	13	6	9	0	5	48	20	0	2	35	51			46	84			6	
80	8	32		3	40	12	40	9	10	5	42	20	30	2	31	52			44	85			5	
90	9	3		3	50	12	15	9	20	5	36	21	0	2	27	53			43	86			4	
100	9	33		4	0	11	51	9	30	5	31	21	30	2	24	54			41	87			3	
				4	10	11	29	9	40	5	25	22	0	2	20	55			40	88			2	
				4	20	11	8	9	50	5	20	23	0	2	14	56			38	89			1	
				4	30	10	48	10	0	5	15	24	0	2	7	57			37	90			0	
				4	40	10	29	10	15	5	7	25	0	2	2	58			35					

To work an Observation, or to find the Latitude of a Place by the Tables of the Sun or Star's Declination and the Zenith Distance.

The Latitude of any Place is its Distance from the Equator, either North or South, counted in Degrees, &c. upon an Arch of the Meridian, contained between the Zenith, or that Point directly over your Head and the Equator. It can never exceed 90 Degrees, and is found by taking the Altitude or Height of the Sun or Star above the Horizon of the Sea with a Quadrant, when on the Meridian or due North or South of the Place of Observation.

This Meridian Altitude, corrected for Dip of the Horizon, and Refraction, and 16 Minutes the Sun's Semi-diameter added thereto, gives the Altitude of his Centre, which being subtracted from 90° gives the Zenith Distance or the Number of Degrees, &c. the Centre of the Object is from the Point over your Head; with which, and knowing how far the Object is to the North or South of the Equator, which is called Declination, the Latitude is found by the Meridian Altitude of any Celestial Object as follows:

First, If the Sun or Star be South when observed, call the Zenith Distance South; but if North, call it North.

Then if the Zenith Distance and Declination be of contrary Names; that is, if the Sun or Star comes to the Meridian in the North, and hath South Declination, or to the South, and hath North Declination, the Zenith Distance, added to the Declination, gives the Latitude of the Place of Observation; and of the same Name the Declination is of, whether North or South.

Secondly, When the Zenith Distance and Declination are of the same Name; that is, when the Sun or Star comes to the Meridian in the North, and hath North Declination; or to the South and hath South Declination, subtract the Lesser from the Greater, and the Remainder is the Latitude; and to know whether it is North or South to observe this general Rule:

When the Declination is greater than the Zenith Distance, the Latitude is of the same Name with Declination; but if less, of a contrary Name.

Note. First, When the Sun or Star is on the Equator, or hath no Declination, the Zenith Distance is the Latitude of the Place, and of a contrary Name to the Zenith Distance.

Secondly, When the Sun or Star is in the Zenith, the Declination is the Latitude, and of the same Name as the Declination is of. For it is evident, that as they are equally distant from the Equator, and on the same Side of it, consequently if the Declination be North, the Latitude will be also North, and if South, South.

EXAMPLE

OF HADLEY'S QUADRANT. 161

EXAMPLE I.

Being at Sea the 27th of May, 1776, the Sun's Meridian Altitude was found to be $57^{\circ} 35'$, and it was South of me; what Latitude was I in?

	$90^{\circ} 0'$
Meridian Altitude	<u>$57 \ 35$</u>
Zenith Distance	$32 \ 25 \text{ S.}$
Sun's Decl. in Table } for May 27 is	$21 \ 23 \text{ N.}$
Latitude in	<u>$53 \ 48 \text{ N.}$</u>

EXAMPLE II.

Being at Sea the 24th of July, 1783 the Meridian Altitude of the Sun was $27^{\circ} 13'$, being North of me; required the Latitude in?

	$90^{\circ} 0'$
Meridian Altitude	<u>$27 \ 13 \text{ N.}$</u>
Zenith Distance	$62 \ 47 \text{ N.}$
Sun's Decl. in Table } for July 24th	$19 \ 53 \text{ N.}$
Latitude in	<u>$42 \ 54 \text{ S.}$</u>

EXAMPLE III.

Being at Sea the 14th of January, 1779, the Sun's Meridian Altitude was found $72^{\circ} 17' \text{ S.}$ What was the Latitude of the Place of Observation?

	$90^{\circ} 0'$
Meridian Altitude	<u>$72 \ 17 \text{ S.}$</u>
Zenith Distance	$17 \ 43 \text{ S.}$
Declination	<u>$21 \ 17 \text{ S.}$</u>
The Latitude in	$3 \ 34 \text{ S.}$

In this Case it is plain, that the Observer was between the Sun and the Equator,

EXAMPLE IV.

Being at Sea the 4th of May, 1784, I observed the bright Star Fomelhaut $27^{\circ} 21'$ above the Horizon of the Sea, and it was North of me; required the Latitude in?

	$90^{\circ} 0'$
Meridian Altitude	<u>$27 \ 21$</u>
Zenith Distance	$62 \ 39 \text{ N.}$
Fomelhaut's Decl. P. Tab.	<u>$30 \ 44 \text{ S.}$</u>
The Latitude in	$31 \ 55 \text{ S.}$

NOTE: The Declination here is fitted to the Year 1784.

The foregoing Rules are for observing by the Sun or Stars when they are at their greatest Altitude, or upon the Meridian above the Pole; but as in some Parts of the Earth the Sun does not set for several Days; and some Stars never set, in that Case they may be observed upon the Meridian twice in the 24 Hours, that is, once at their greatest Height as before, and again when they are at their lowest or upon the Meridian below the Pole; to work which Observations, take the following

RULE. Add the Complement of the Declination to the Meridian Altitude, the Sum is the Latitude of the same Name with the Declination.

EXAMPLE V.

At Sea I took the Altitude of the North Pole Star, when on the Meridian below the Pole, and found it $46^{\circ} 21'$; required the Latitude?

X

The

The Meridian Altitude
Com. Declination

46° 21' N.
1 53

The Latitude in

48 14 N.

In the following Examples the Corrections for Dip and Refraction are introduced.

EXAMPLE VI.

By a fore Observation the Altitude of the Sun's lower Edge was found by Hadley's Quadrant to be 40° 20' S. when his Declination was 9° 56' N. the Eye being 30 Feet above the Horizon.

Required the Latitude of the Place.

Obf. Alt. Sun's low. Edge 40° 20' S.
Semi-diam. to be added 0 16

App. Alt. Sun's Centre 40 36

Dip. of Hor. to be subtr. 0 05

App. Alt. Cor. by the Dip. 40 31

Refract. to be subtr. 0 01

True Alt. of Sun's Centre 40 30

True Zenith Distance 49 30 S.

Declination 9 56 N.

Latitude 59 26 N.

EXAMPLE VII.

By a back Observation with Hadley's Quadrant the apparent Altitude of the Sun's lower Edge was 25° 12' S. when his Declination was 21° 14' S. and the Eye 40 Feet above the Horizon. In what Latitude was the Observation made?

Obf. Alt. Sun's low. Edge 25° 12' S.
Semi-diam. to be subtr. 0 16

App. Alt. Sun's Centre 24 56

Dip. of Hor. to be added 0 06

App. Alt. Cor. by the Dip. 25 02

Refract. to be subtr. 0 02

True Alt. of Sun's Centre 25 00

True Zenith Distance 65 00 S.

Declination 21 14 S.

Latitude 43 46 N.

EXAMPLE VIII.

Suppose the Eye of an Observer at 35 Feet above the Water should with Hadley's Quadrant, by a fore Observation, find the Altitude of Sirius 53° 35' S. when it passed the Meridian, having before Hand set his Watch, and found the Time of Sirius' Passage; required the Latitude of the Place of Observation?

Obf. Alt. of Sirius 53° 35' 00" N.
Dip of Hor. to be sub. 0 05 39

Ap. Alt. above Hor. 53 29 21

Refract. to be sub. 0 00 42

True Alt. of Sirius 53 28 39

True Zen. Dist. 36 31 21 S.

Sirius' Declinat. 16 25 0

Latitude 20 06 21 N.

EXAMPLE IX.

Suppose on the 12th of June, 1784, an Observer in an high Northern Latitude, and 65° to the West of London, his Eye being 28 Feet high, observed the Altitude of the Sun's lower Limb on the Meridian below the Pole, to be 8° 15' North, by a fore Observation with Hadley's Quadrant; required the Latitude?

The Sun being observed below the Pole, it must have been at 12 Hours past Noon, at the Place of Observation, and that Place being 65° West of London = 4 Hours 20 Minutes later than at London, there.

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therefore it must have been 16 H. 20 M. past Noon at London. Ap. Alt. Sun's low. Limb $8^{\circ} 15' N.$
Semi-diam. added 16

June 12th, 1784, the Sun's Declination $23^{\circ} 14'$ North, the Daily Variation is 3 Minutes, and 24 H. 3' :: 16 H. 20 M. : $2' 10''$, which added to $23^{\circ} 14'$ (because the Declination is increasing) gives $23^{\circ} 16' 10''$, the Sun's Declination at the Time of Observation.	App. Alt. Sun's Centre	8 31
	Dip. of Hor. sub.	5
	Sun's Alt. Cor. by Dip.	8 26
	Refrac. sub.	6
	True Alt. Sun's Centre	8 20
	Comp. Sun's Decl.	66 44
	Latitude in	75 4 N.

To find the Latitude by observing the Meridian Altitude of the Moon.

First, find the Time of the Moon's passing over the Meridian of Greenwich in the Ephemeris, (Page 6,) to which apply the Longitude turned into Time by Addition or Subtraction, according as the Longitude is E. or W. which call reduced Time.

To this Time, find the Moon's Semi-diameter, and Horizontal Parallax, in Page the 7th of the Month in the Ephemeris.

Correct the Observed Altitude for her Semi-diameter and Dip, to which add the Correction for her Observed Altitude, and Horizontal Parallax, from Table II. and you will have the Moon's true Altitude, hence her Zenith Distance, to which apply her Declination, and you will have the true Latitude.

N. B. The Moon's Declination is found by taking the Difference between her Declination the nearest Noon and Midnight to the reduced Time, and then saying, As 12 H. : is to that Difference :: so is the reduced Time to a Number of Degrees and Minutes ; which applied to her Declination, the nearest Noon or Midnight preceding to the reduced Time, according as the Declination is increasing or decreasing, gives the Moon's true Declination at the Place of Observation.

E X A M P L E.

August 14th, 1786, being in Longitude $45^{\circ} W.$ of Greenwich, the Meridian Altitude of the Moon's upper Limb was $67^{\circ} 43' \frac{1}{2}$, the Zenith Distance being South, the Observer's Eye being 23 Feet above the Surface of the Sea, required the Latitude in ?

By the Ephemeris that Day the Moon passes over the Meridian of Greenwich at 16 H. 13 M. that is 4 H. 13 M. after Midnight, which added to 3 H. the Longitude in Time W. of Greenwich, gives 7 H. 13 M. after Midnight, at the Place of Observation, nearly.

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At this Time (in Page the 7th of the Month in the Ephemeris) the Moon's Semi-diameter is found to be $16' 15''$ and her Horizontal Parallax $59' 38''$

Observed Altitude of the Moon's Upper Limb	$67^{\circ} 43' 30''$	
Moon's Semi-diameter	$16^{\circ} 15'$	} Sum
Dip for 23 Feet	$4 34$	

20 49

Correction from Tab. II. for Hor. Par.

$67 22 41$
 $22 55$

To find the Declination True Alt,

$67 45 36$
 $90 0 0$

Zenith Dist. $22 14 24$

Moon's Decl. Aug. 14 at Mid. $16^{\circ} 7' N.$ $16^{\circ} 7'$ Decl.
Moon's Ditto Aug. 15 at Noon $18 31 N.$ $1 26$ Diff.

Diff. of Decl. in 12 Hours	$2 24$	$17 33$ Tr. De. $17 33 0 N.$
Then as 12 H. : $2^{\circ} 24' : 7 H. 13' :$		
$1^{\circ} 26'$ Diff.		True Lat. in $39 47 24 N.$

Note. If the nearest Minute be taken and the second rejected, it will be sufficiently correct for finding the Latitude.

To find the Latitude by a Planet.

In the Nautical Almanack find the Time of the Planet's passing the Meridian of Greenwich, reduce this Time to the Meridian of the Ship, then, having the Meridian Altitude and Declination, the Latitude is found as by a fixed Star.

The Declination is set down for every six Days, but may be found for any intermediate Days, by taking proportional Parts.

E X A M P L E.

May 1st, 1786, in Longitude $15 W.$ the Meridian Altitude of Jupiter was found to be $57^{\circ} 40'$, the Zenith Distance being South of the Observer. Required the Latitude?

Jupiter and Venus are the brightest of all the Planets, and may be seen in the Mornings and Evenings.

Jupiter passes the Meridian of Greenwich that Day at 16 H. $31'$, that is 4 H. 31 Minutes after 12 at Night, and 1 H. the Long. in Time $W.$ added to 4 H. $31 M.$ is 5 H. $31 M.$ the Time of his passing the Meridian of the Ship, his Declination being $16^{\circ} 55' N.$ Now $90^{\circ} - 57^{\circ} 40' = 32^{\circ} 20'$ the Zen. Dist, and $32^{\circ} 20' + 16 55 =$ Lat North.

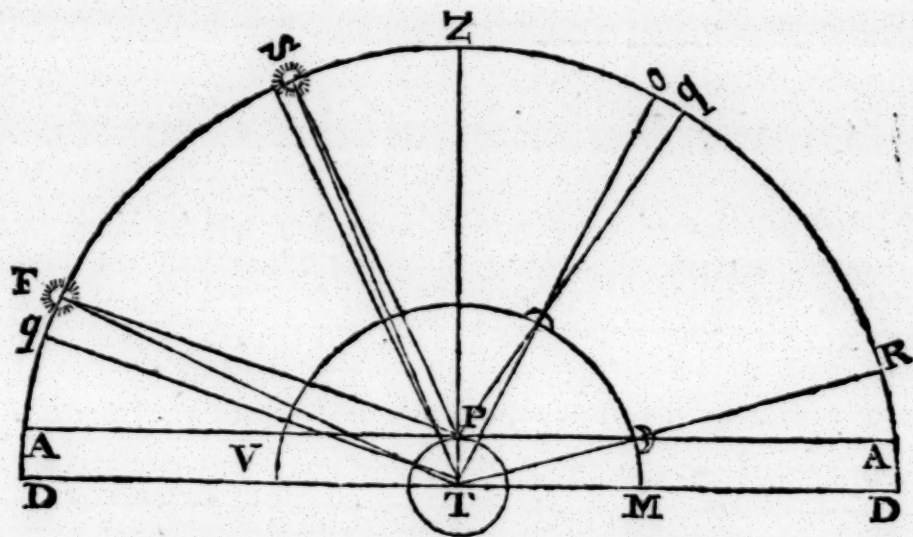
These Methods are the more convenient, as the Moon and Planets can be seen when the fixed Stars cannot be so well defined.

Of

O F T H E P A R A L L A X.

PARALLAX is the Difference between the Altitude of the Sun, Moon, or Star, and the Altitude of the same Object seen at the same Time from the Earth's surface, or it is the Angle the Earth's Semi-diameter would appear under by an Observer placed at the Sun, Moon, or Star.

The Parallax of the Heavenly Bodies are greatest when in the Horizon, hence called the Horizon Parallax; that of the Moon's is set down in the Nautical Almanacks for every Noon and Midnight, and lies between $54'$ and $62'$, the Parallax diminishes according to the Altitude of the Object until it comes to the Zenith, where it is nothing; the Difference of the Elevation of Objects is called the Parallax in Altitude, and it is easily calculated by saying, as Radius is to the Horizontal Parallax, so is the Co-sine of the Altitude to the Parallax in Altitude: Now, as all Objects are depressed by their Parallax, so they are elevated above their true Altitudes by Refraction. To save the Mariner trouble their Difference is set down in Table II. this Correction or Difference added to the Moon's Apparent Altitude gives her true Altitude.



Let PT represent the Earth, T the Centre, M & V a part of the Moon's Orbit, DD part of the Sun's Orbit, and the rational as well as AA is the sensible Horizon.

Now, an Observer at T will see the Moon in the Line TR , when another at P at the same Time will see her in the Line PA in the sensible Horizon, and the Angle $PTM = MTR = \angle R$ is the Horizontal Parallax set down in the Nautical Almanack for every Noon and Midnight, and lies between $54'$ and $62'$; this Angle diminishes

minishes as the Object approaches the Zenith, for suppose the Moon in the Line Pq the $\angle q \odot o = P \odot T$ is less than the $\angle A \odot R = \angle T \odot P$, still diminishing until it comes to the Zenith Z where it is nothing. To find the Diminution of Parallax in Altitude, say, as Radius : is to the Horizontal Parallax :: so is the Co-sine of the Apparent Altitude : to the Parallax in Altitude, the Difference between the Parallax and Refraction is the Correction set down in Table II.

The Parallax of the Moon is greater than any of the rest of the Planets, owing to her being nearest the Earth, the vast Distance of Sun and Stars, rendering their Parallax so small that they are often neglected in Nautical Calculations, for suppose the Sun at F or S then the Angle $T F P = q$ $T F$ is the Sun's Parallax about $8 \frac{1}{2}$ seconds.

Having the Earth's Semi-diameter and the Parallax of any of the Planets, their Distance may be found, by saying, as the Tangent of the Parallax : is to the Earth's Semi-diameter in Miles ; so is Radius : to the Distance.

Having the Distance the Parallax is found by saying, As the Distance is to Radius :: so is the Earth's Semi-diameter ; to the Tangent of the Parallax.

The Earth's Semi-diameter is 1146 Nautical Leagues, the Sun's Distance from the Earth is 27,809,344, the Moon 69,059, Mercury 10,764,563, Venus 20,115,400, Mars 42,372,897, Jupiter 144,635,833, and Saturn 265,283,603 Leagues.

Of the Variation of the Compass.

THE Variation of the Compass is an Arch of the Horizon contained between the Meridian of the Place and the Magnetic Meridian, and is either East or West ; or it is the Number of Degrees, &c. the Needle's Point stands from the true North or South Points of the Horizon, reckoned to the Eastward or Westward, and is readily found either from the Sun's Amplitude or Azimuth.

To find the true Amplitude.

The Sun's true Amplitude is an Arch of the Horizon comprehended between the true East or West Points thereof, and the Centre of the Sun at his Rising or Setting ; or it is the Number of Degrees, &c. the Sun rises or sets to the Northward or Southward of the East or West Points of the Horizon.

The Sun's Magnetic Amplitude is the Number of Degrees, &c. the Centre is Northward or Southward of the East or West Points
of

OF THE VARIATION OF THE COMPASS. 167

of the Compass at his Rising or Setting, and is found with an Azimuth Compass in the following Manner:

Move the Box about till the four Cardinal Points of the Card coincide with the four Lines in the Sides of the Compass-Box: keep the Box steady, and turn the Index till the Centre of the Sun at Rising or Setting, when his lower Edge just touches the Horizon is seen through both the Sights; then the Degrees between the North Point of the Compass, and the End of the Index pointing to the Sun, will be the Magnetic Amplitude given.

The true Amplitude is found either by Inspection in the Tables of the Sun's Amplitude, or by Calculation as follows:

R U L E. As the Sine Complement of the Latitude
Is to Radius,
So is the Sine of the Sun or Star's Declination
To the Sine of the true Amplitude;

Which is always of the same Name with the Declination, whether North or South.

Or, to the Arithmetical Complement of the Sine Complement of the Latitude add the Sine of the Sun's Declination, and that Sum will be the Log. of the Sine of the true Amplitude.

NOTE. The Arithmetical Complement of the Co-sine of any Arch is always equal to the Secant of that Arch, throwing away Radius, or neglecting one, which stands the first Figure in the Secant's Index; likewise the Arithmetical Complement of the Sine of any Arch, is the Co-secant of that Arch less Radius, or the first Figure of its Index: Wherefore, the Arithmetical Complement of the Sine or Co-sine of any Arch is found in the Table of Secants by Inspection.

E X A M P L E I.

On the 20th of October, 1781, in Latitude $51^{\circ} 32' N$. I demand the true Amplitude?

As Sine Com. Lat. $51^{\circ} 32'$	9.79383	Or to Ar. Com. Sine	} 0.20617
Is to Radius	10 00000	Co. Lat. $51^{\circ} 32'$	
So is Si. S's Dec. $10^{\circ} 34' S$.	9.26335	Add Sine Sun's Declination to $34 S$.	} 9.26335
To Si. of true Amp. $17^{\circ} 9'$	9.46952	Sine of the true Amp.	
		17.9 S.	} 9.46952
		Which is South, because the Declination is South	

E X A M P L E

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E X A M P L E II.

In Latitude $38^{\circ} 25' N.$ what is the Sun's true Amplitude when the Declination is $18^{\circ} 59' N.$

As Sine Com. Lat. $38^{\circ} 25'$	9.89405	Or to the Secant	} $38^{\circ} 25'$ 0.10594
Is to Radius	10.00000	less Rad.	
So is Sun's Decl. 18.59	9.51227	Add Si. Sn's Decli. $18^{\circ} 59'$	9.51227
To Sun's true Amp. $24^{\circ} 32'$	9.61822	Sine true Ampl:	$24^{\circ} 32'$ 9.61822
		Which is North, because the Declination is North	

To find the true Amplitude by the Table of Amplitudes.

Look for the given Declination at the Top of the Table, and the Latitude in the first Column on the Left Hand in the common Angle of meeting, will be the Degrees and Minutes of the Amplitude required.

E X A M P L E I.

In Latitude $40^{\circ} N.$ when the Declination was $17^{\circ} N.$ required the Sun's true Amplitude at Rising?

Under Declination 17° , and right against the Latitude 40° , stand $22^{\circ} 26'$. the true Amplitude, and is to be counted from the East towards the North, because it is at the Sun's Rising, and the Declination is North; that is, E. $22^{\circ} 26' N.$

But when the Latitude is given in Degrees, and the Declination in Degrees and Minutes, find the Declin. at the Top as before, and the nearest Degrees to the given Latitude in the Left Hand Column, against which, and under the given Declin. stands the true Amplitude; or, if the Minutes of the Declination be near 30, or half a Degree, find the Amplitude for the given Degrees of Declination, and the Amplitude for one Degree above it, add these two Amplitudes together, half their Sum will be the true Amplitude, sufficiently exact for Practice at Sea.

E X A M P L E II.

Suppose I would know the Sun's true Amplitude at his Setting in Latitude 57° , his Declination being $11^{\circ} 33' S.$

Find the Ampl. as before for the $\{ 11^{\circ} \}$ which will be $\{ 20^{\circ} 29' \}$
 Lat. 57° , and the Declinations $\{ 12 \}$ $\{ 22 \}$ 25

their Sum $42 \quad 54$

Half the Sum $21 \quad 27$ is
 the

VARIATION OF THE COMPASS. 169

the true Amplitude; that is, W. $21^{\circ} 27'$ S. because at Sun Setting, and the Declination South. In like Manner, if the Declination be in Degrees, and the Latitude in Degrees and Minutes, as in

E X A M P L E III.

Suppose it were required to find the Sun's true Amplitude at Setting in Latitude $49^{\circ} 27'$, when his Declination was 21° N.

Now 27 Minutes being nearly Half a Degree, therefore,

For Lat. 49°	{ and Declination 21°	}	$33^{\circ} 6'$
For Lat. 50	{ the Amplitudes are }		$33 52$

Sum $66 58$

Half the Sum is $33 29$, the true Amplitude required; that is, W. $33^{\circ} 29'$ N. because the Sun was Setting, and the Declination N.

When the Latitude and Declination are both given in Degrees and Minutes, take the nearest Degrees to both, unless they are near 30 Minutes, as observed before, and find the Amplitude as in Example I.

E X A M P L E IV.

Suppose it were required to find the Sun's true Amplitude at Setting, in Latitude $49^{\circ} 18'$, his Declination being $19^{\circ} 41'$ N.

Now as the Latitude is nearest to 49° , and the Declination nearest 20° , therefore against Latitude 49° and under Declination 20, stands $31^{\circ} 25'$ N. the true Amplitude; that is, W. $31^{\circ} 25'$ N. the Declination being North, and at the Sun's Setting.

To find the true A Z I M U T H.

The true Azimuth is an Arch of the Horizon, contained between the Meridian of the Place and the Azimuth Circle, passing through the Centre of the Sun or Star at the Time of Observation; or it is the true Distance of the Sun or Star from the true North and South Points of the Compass.

The Magnetic Azimuth is an Arch of the Horizon contained between the Magnetic Meridian and the Azimuth Circle, passing through the Centre of the Sun or Star when observed; or it is the apparent Distance of the Sun or Star from the North or South Points of the Compass, either in the Forenoon or in the Afternoon when they are 5° , 10° , 15° , &c. above the Horizon, and the less the Altitude is, the more exact you may perform the Observation.

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The

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The Magnetic Azimuth is found by the Compass, in the following Manner :

Set the Box so that the four Cardinal Points of the Card stand opposite to the four Lines in the Compass Box : hold the Box in this Position, and move the Index, till the Sights being directed to the Sun or Star's Centre, the Shadow of the String joining the Sights fall directly along the Middle of the Index ; then the Degree, &c. in the Arch intercepted between the End of the Index next the Sun, and North Point of the Card, will give the Magnetic Azimuth required. If the Sun does not shine strong enough to give a strong Shadow, look through one of the Sights, and move the Index till one of the Strings cuts the Sun's Centre, and then the intercepted Arch, as before, shews the Sun's Azimuth, and the like of the Star's.

When there is a rough Sea, the Observation is best made by two Persons, and if the Card vibrates much take the middle Degree between the Limits which the Vibration reaches.

When the Azimuth is observed, the Altitude of the Object must be observed at the same Time.

Having the Latitude of the Place of Observation, and the Sun or Star's Declination with the Altitude at the Time of Observation, the true Azimuth is found as follows :

RULE. Add the Complement of the Latitude, the Complement of the Altitude, and the Sun or Star's Polar Distance into one Sum : From Half that Sum subtract the Polar Distance, and note the Half Sum and the Remainder.

Then add together

The Arithmetical Comp. of the Co sine of the Latitude.

The Arithmetical Comp. of the Co-sine of the Altitude,

The Sine of the Half Sum,

And the Sine of the Remainder into one Sum.

Half the Sum of these four Logarithms will give the Co-sine of Half the true Azimuth, which, being doubled, gives the true Azimuth, reckoned from the North in North Latitude, and from the South in South Latitude.

N. B. The Polar Distance of the Sun or Star, is their Distance from the nearest, or elevated Pole, and if the Latitude of the Place, and the Declination of the Sun or Star, be both North or both South, then the Complement of the Declination is the Polar Distance ; but if the Latitude and Declination be one North and the other South, the Declination added to 90° gives the Polar Distance.

EXAMPLE

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E X A M P L E I.

In Latitude $43^{\circ} 39'$ N. the Sun's Altitude was observed to be $39^{\circ} 28'$, his Declination being then $16^{\circ} 37'$ North, required his Azimuth ?

Lat.	$90^{\circ} 00'$ 43 39 N:	Altitude	$90^{\circ} 00'$ 39 28	Declination	$90^{\circ} 00'$ 16 37
Co. Lat.	46 21	Co. Alt.	50 32	Polar Dist.	73 23
Comp. Lat.	46 21	Co. Lat.	$46^{\circ} 21'$	Ari. Co. Sine	0,14052
Comp. Alt.	50 32	Co. Alt.	50 32	Ari. Co. Sine	0,11239
Polar Dist.	73 23	Half Sum	85 8	Log. Sine	9,99843
Sum	$170^{\circ} 16'$	Rem.	11 45	Log. Sine	9,30887
Half Sum	85 8	Sum of the fourth Logarithms			19,56021
Sub. Po. Dist.	73 23	Half the Sum Co-fine	52 56		9,78010
Remainder	11 45	And $52^{\circ} 56'$ doubled, gives $105^{\circ} 52'$ for the Sun's true Azimuth to be reckoned from the North.			

E X A M P L E II.

In Latitude $42^{\circ} 16'$ N. the Sun's Altitude was observed to be $18^{\circ} 40'$ his Declination being then $7^{\circ} 38'$ S. required his Azimuth ?

Comp. Lat.	$47^{\circ} 44'$	Co. Lat.	$47^{\circ} 44'$	Ari. Co. Sine	0,13075
Comp. Alt.	71 20	Co. Alt.	71 20	Ari. Co. Sine	0,02347
Polar Dist.	97 38	Half Sum	108 21	Log. Sine	9,97733
Sum	216 42	Remainder	10 43	Log. Sine	9,26940
Half Sum	108 21	Sum of the four Logarithms			19,40095
Sub. Po. Dist.	98 38	Half the Sum is equal to Co-fine	59 53		9,70047
Remainder	10 43	And $59^{\circ} 53'$ doubled, gives $119^{\circ} 46'$ for the Sun's true Azimuth to be reckoned from the North			

Question. I. Being at Sea, in Latitude $40^{\circ} 38'$ N. in the Afternoon the Sun's Altitude was observed to be $20^{\circ} 46'$, when his Declination was $17^{\circ} 10'$ S. What was the Sun's Azimuth at that Time ?

Answer. $137^{\circ} 52'$ from the North.

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Question. II. What is the Sun's true Azimuth in Latitude $26^{\circ} 30' N.$ in the Forenoon, when his Altitude is $24^{\circ} 28'$, and his Declination $22^{\circ} 40'$ North?

Answer. $75^{\circ} 44'$ from the North Point of the Compass.

Question. III. At the Island of St. Helena, the Sun's Altitude was observed to be $30^{\circ} 22'$ in the Forenoon, his Declination being then $22^{\circ} 58'$ S. Required the Azimuth at that Time?

Answer. $72^{\circ} 26'$ from the South, or $107^{\circ} 34'$ from the North.

Question. IV. What Point of the Compass does the Star Aldebaran bear on, at the Cape of Good Hope, when its Altitude is $22^{\circ} 25'$?

Answer. $130^{\circ} 8'$ from the South, or $49^{\circ} 52'$ from the North.

Having found the Sun's true Amplitude, or Azimuth, by the preceding Methods, &c. Magnetic Amplitude or Azimuth by Observation, it is evident, that when they agree there is no Variation; but when they disagree, then, if the true and observed Amplitudes be both of the same Name, that is, both North or both South, their Difference is the Variation; but if the true and observed Amplitudes be of different Names, that is, one North and the other South, their Sum is the Variation. Again, if the true and observed Azimuths be both on the East, or both on the West Side of the Meridian, their Difference is the Variation; but if the true and observed Azimuths be one on the East and one on the West Side of the Meridian, their Sum gives the Variation; and to know whether the Variation is Easterly or Westerly, observe this general Rule, viz.

Let the Observer's Face be turned to the Sun, then, if the true Amplitude or Azimuth be to the Right Hand of the Magnetic, or Observed, the Variation is Easterly, but if to the Left Hand, Westerly.

EXAMPLE

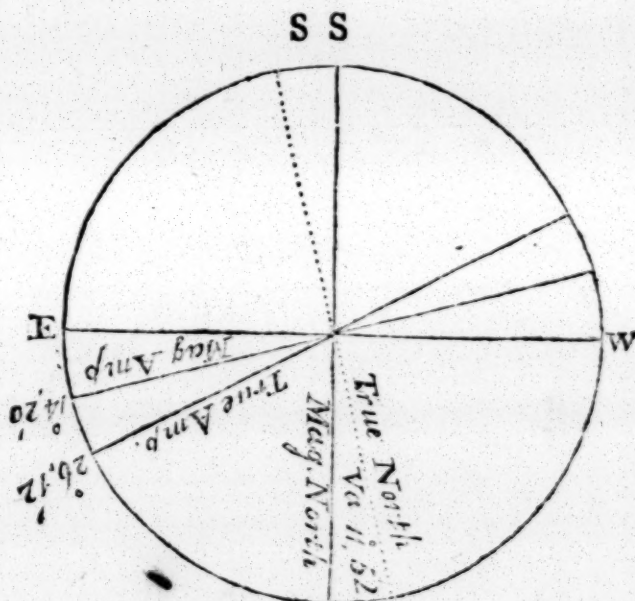
E X A M P L E I.

Suppose the Sun's true Amplitude at Rising is found to be E. $14^{\circ} 20'$ N. but by the Compass it is found to be E. $26^{\circ} 12'$ N. required the Variation ?

From the greater	E. $26^{\circ} 12'$ N.
Take the lesser	E. $14^{\circ} 20'$ N.

Remains the Variation	<u>11 52 E.</u>
-----------------------	-----------------

Which is Easterly, because in this Case the true Amplitude is to the Right of the Observed.



With the Chord of 60 describe a Circle to represent the Horizon, through which draw the North, South, East and West Lines, take the true Amplitude found by Calculation at Rising, $26^{\circ} 12'$ from the Line of Chords, and setting it from E. towards N. as likewise the Chord of the Magnetic Amplitude $14^{\circ} 20'$, and set from E. towards N. as before, the Difference of these two Angles, or between the true and Magnetic Amplitude, viz. $11^{\circ} 52'$ is the Variation. Now suppose yourself placed at the Centre of the Horizon, represented by the Compass, and looking towards the Magnetic Amplitude at the Sun's Rising, it is plain that the true Amplitude found by Calculation is towards the left Hand of the Observed, which shews the Variation is $11^{\circ} 52'$ W. and must be allowed to the left Hand in all Courses steered, before they can be put into the Traverse Table or Bearings, taking by the Compass.

E X A M P L E

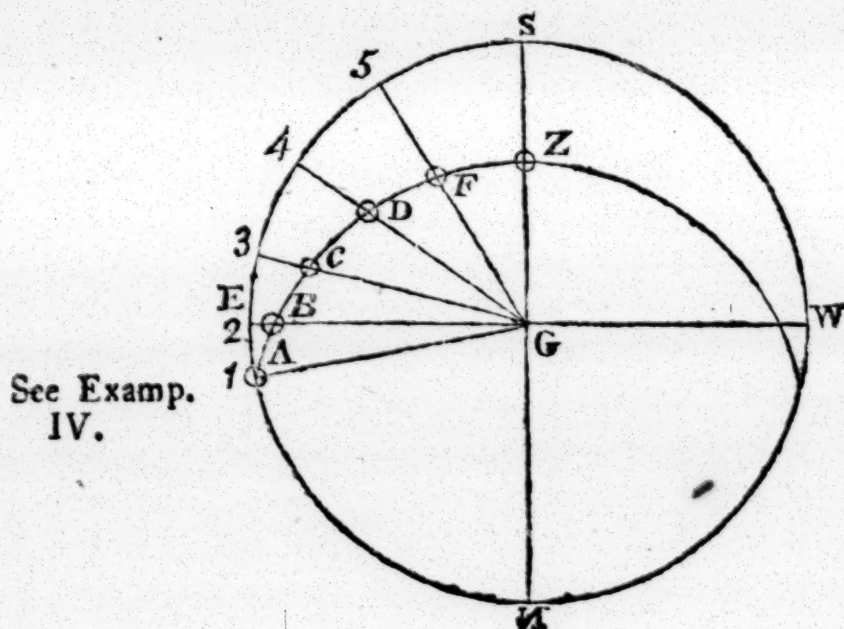
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E X A M P L E II.

Suppose the Sun's true Amplitude at Setting be W. $34^{\circ} 26' S.$ and his Magnetic Amplitude W. $23^{\circ} 13' S.$ required the Variation, since they are both of the same Name ?

From the greater	W. $34^{\circ} 26' S.$
Take the lesser	W. $23^{\circ} 13' S.$
Remains the Variation	<u>11 13 W.</u>

Which is Westerly, because the true Amplitude is to the Left of the Observed in this Case.



Let North, East, South, West, represent the Horizon, A, B, C, D, an Azimuth Circle, passing through the Sun's Centre; now an Observer placed at the Centre G, will see the Sun at Rising in the Line G 1, but when he gets a greater Altitude, and arrives at B he will see the Sun in the Line G 2, and as the Sun alters its Altitude, will be seen as in the Lines G 3, G 4, G 5, at Length will arrive at its Meridian G z S, and the Figures 2, 3, 4, 5, will represent the Magnetic Azimuth; the Difference between these and the true Azimuth found by Calculation is the Variation.

E X A M P L E

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EXAMPLE III.

Suppose the Sun's true Amplitude at Rising is E. $13^{\circ} 24'$ N. and his Magnetic Amplitude E. $12^{\circ} 32'$ S. required the Variation, and which Way?

Since the true Amplitude and Observed have different Names.

To the true Amplitude E. $13^{\circ} 24'$ N.
Add the Magnetic Am. E. $12^{\circ} 32'$ S.

—————
The Sum is the Variation $25^{\circ} 56'$ W

Which is Westerly, because the true Amplitude is to the Left of the Observed.

EXAMPLE V.

Suppose the Sun's true Azimuth is N. $32^{\circ} 28'$ Easterly, and his Magnetic Azimuth N. $8^{\circ} 50'$ West, required the Variation, and which Way?

Since they are on the different Sides of the Meridian,

To the true Azimuth N. $32^{\circ} 28'$ E.
Add the Mag. Azim. N. $8^{\circ} 50'$ W.

—————
Sum is the Variation $41^{\circ} 18'$ E.

Which is Easterly, because the true Azimuth is to the Right of the Observed.

EXAMPLE IV.

Suppose the Sun's true Azimuth in the Forenoon is N. $86^{\circ} 40'$ Easterly, but by the Compass it is N. $73^{\circ} 24'$ Easterly, required the Variation, and which Way?

Since the true and observed Azimuths are both on the same Side of the Meridian,

From the greater N. $86^{\circ} 40'$ E.
Take the lesser N. $73^{\circ} 24'$ E.

—————
Remainder Variation $13^{\circ} 16'$ E.

Which is Easterly, because the true Azimuth is to the Right of the Observed.

EXAMPLE VI.

Suppose the Sun's true Azimuth S. $17^{\circ} 45'$ E. and the Magnetic Azimuth S. $5^{\circ} 48'$ West, required the Variation, and which Way?

Since they are on different Sides of the Meridian,

To the true Azimuth S. $17^{\circ} 45'$ E.
Add the observed Az. S. $5^{\circ} 48'$ W.

—————
Sum is the Variation $23^{\circ} 33'$ E.

Which is East, because the true Azimuth is to the Right of the Observed.

The Use of the Variation is to correct the Course steered by the Compass; when the Variation is East, it must be allowed to the Right Hand upon every Course steered quite round the Compass; but when the Variation is West, to the Left Hand.

Note. The Variation may be easily found by taking the Sun's Altitude in the Morning, and observing what Point of the Compass he bears upon; and in the Afternoon when the Altitude is the same, the middle Point will be the true Meridian, the Difference between which and the North or South Points of the Compass is the Variation. If the Altitudes are taken at 5, 6, or 7 o'Clock in the Morning, you will have the same Altitude at 5, 6, or 7 o'Clock in the Evening, being equally distant from Noon.

The Variation of the Compass was first observed at London, in the Year 1580, to be $11^{\circ} 15'$ Easterly; and in the Year 1622, it

was

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was $60^{\circ} 0'$ E. still decreasing, and the Needle approaching the true Meridian, until it coincided with it in the Year 1662, since that Time the Variation still continues at London to increase Westerly, at the Rate of about 11 or 12 Minutes every Year; and is at this Time about $22^{\circ} 30'$ Westerly, and in the English Channel about $23^{\circ} 40'$ Westerly; but how far it will go that Way, Time and Observations will probably be the only Means to discover.

The Variation at Paris in the Year 1640, was 3° E. but in the Year 1681 it was $2^{\circ} 21'$ W. and is now about $21^{\circ} 20'$ Westerly, still continuing to go Westerly.

In short, from Observations made in different Parts of the World, it appears, that in different Places the Variation differs, both as to its Quantity and Denomination, it being East in one Place, and West in another; the true Cause and Theory of which has not yet been discovered, and therefore in long Voyages it is absolutely necessary that the Mariner should find the Variation of the Compass by Observation as often as possible.

One Magnus, a Shepherd, first discovered the wonderful Power of the Loadstone, that gives Polarity to the Needle, by its sticking to the Iron of his Sandals; whence the Name of Magnèt was given to the Stone or Magnetic Needle. Gio, of Naples, about 300 Years ago, first discovered that a Piece of Iron rubbed on it, and then suspended, had the Property of pointing to the North and South, and thence applied to Navigation. An Author of some Degree of Popularity, who has drawn a Variation Chart, says, he has found out the Theory of the Variation of the Magnetic Needle, without favouring the World with the Principles; if his Genius has been able to penetrate into the Bowels of the Earth, to discover this wonderful Phenomenon, it is more than Sir Isaac Newton's, or Dr. Halley's could do; however his Veracity may well be doubted, as Mr. Wales, who accompanied Capt. Cook round the World, told me, that his Theory did not reach those Islands which they discovered.

How to touch the Compass Needles.

Having two strong Magnetical Bars, lay the Compass-Needle as nearly North and South as you can, with the intended North and Northwards, join the two Magnets in a Line, considerably above the Needle, the North End of each being Northward, and bring them down upon the Needle, so that the Place of junction may be over its Centre, then draw them asunder along each half of the Needle, and continue their Motion till they are eight Inches clear of the Needle's End; by a circular Motion bring them again to the Centre and join them as before; repeat this Operation six or seven Times, taking Care not to put the Magnets out of their Parallelism, and the Needle will be sufficiently Magnetical.

Of the LOG-LINE, and HALF-MINUTE GLASS,
and how to correct the Distance given by them.

THE Log is a flat Piece of Wood like a Flounder, or of the Figure of a Quarter of a Circle, having its circular Side loaded with Lead sufficient to make it swim upright in the Water. To this Log is fastened a long Line of about 150 Fathoms, called the Log-Line, which is divided into certain equal Spaces, called Knots, each of which ought to bear the same Proportion to a Nautical Mile (60 of which make a Degree) that Half a Minute does to an Hour, that being the Time allowed for the Experiment.

They are called Knots, because at the End of each of them there is a Piece of Twine with Knots in it, reeved between the Strands of the Line; these Pieces of Twine shew how many Knots run out in Half a Minute, and consequently the Ship's Rate of Sailing per Hour.

Mr. Norwood, and several other able Mathematicians, have found that a Degree of a great Circle upon the Earth contains about 367200 English Feet, therefore a Nautical Mile being the $\frac{1}{60}$ Part of 367200 Feet, that is, 6120 Feet, and since Half a Minute is $\frac{1}{120}$ Part of an Hour, the Length of a Knot on the Log-Line ought to be the $\frac{1}{120}$ Part of 6120 Feet, or 51 Feet. But as for the most Part the Ship's Way is found, by Experience, to be really more than that given by the Log, and as it is safer to have the reckoning before the Ship than after it, therefore 50 Feet may be taken as the proper Length of each Knot, and these Knots subdivided into ten Fathoms, each of 5 Feet, which is certainly the best adapted for Practice, and will correspond with all the Tables and Instruments used in Navigation, as they are decimally divided, and consequently, the Ship's Run determined with greater Ease and Certainty. But some experienced Commanders find, that the allowing 50 Feet to a Knot, generally makes the Ship a-head of the Reckoning; and to avoid Danger, mostly divide the Log-Line into Knots of 7 or $7\frac{1}{2}$ Fathoms of 6 Feet each, to correspond with a Glass that runs 28 Seconds. Others, again, divide the Seconds the Glass runs by 4, and take the Quotient for the Distance in Fathoms between the Knots; which of these Methods are best, I leave to every Captain's own Experience to determine; but certain it is, that whatever Length the Knots are, the most convenient Way is to divide them into Tenths.

In hot or dry Weather, the Glass runs out faster than in moist or rainy Weather; therefore Care should be taken to try what Number of Seconds the Glass runs.

The Length of the Log-Line formerly used, was divided into Knots of 42 Feet, which Way of dividing the same was founded on the Supposition, that 60 Miles, of about 5000 English Feet, made a Degree; whereas it is abundantly certain, that a Degree contains about 73 such Miles. It were therefore to be wished, that no Line so divided were in Use, but very often Custom prevails over Reason; and although Mariners find by Experience this Length of the Knots to be too short, yet some of them, rather than quit the old Way, use Glasses for Half Minute ones that run but 24 or 25 Seconds, which is but correcting one Mistake by another.

The Knots commonly begin to be counted at the Distance of 10, 12, or 15 Fathoms from the Log, according to the Largeness of the Ship, that so the Log may be out of the Ship's Wake when it is thrown over Board before they begin to count, lest the Eddies should suck the Log after the Ship; and for the more ready Discovery of this Point of Commencement, there is commonly fastened at it a Piece of red Rag; that Part of the Line between the red Rag and the Log, is called the Stray Line.

The Log and Log-Line being duly prepared and hove overboard from the Poop, or Lee Quarter, and the Line veered out (by the Help of a Reel which turns easy, and about which it is wound) as fast as the Log will carry it away, or rather as fast as the Ship sails from it, will shew how fast the Ship has sailed in the given Time, or Rate of Sailing per Hour.

The Experiment for finding the Velocity of the Ship is called heaving the Log.

Care should be taken to veer out the Line as fast as the Log takes it, for if the Log is left to turn the Reel of itself, the Log will come home, and deceive you in the Reckoning.

In King's Ships, India Ships, and some others, the Log is hove every Hour, but in Coasters, and those using short Voyages every two Hours.

Here the Ship is supposed to move with equal Velocity between the Times of trying the Experiment. But if the Gale has not been the same during the whole Hour, or Time between heaving the Log, or if there have been more Sail set, or any hauled, that so the Ship has run more or less in any Part of the Hour than she did at the Time of the Experiment; or if it should fall little or more Wind at that Time, there must be Allowance made for it according to the Discretion of the Artist: Sometimes too when the Ship is before the Wind, and a great Sea setting after her, it will bring home the Log; in such Cases it is customary to allow one Mile in ten, and less in Proportion, if the Sea be not so great.

Care should also be taken to measure the Log-Line pretty often, lest it stretch, and deceive you in the Distance.

The like Regard must be had, that the Half Minute Glass be just 30 Seconds, otherwise no Account of the Ship's Way can be kept;

kept; to prove which, if there be no Stop Watch at Hand, let a Plummert, of any Form or Weight, be fastened to a Silk String or Thread, with a Loop to hang on a small Pin or Nail fastened in any Place, so that the Plummert may swing freely; let it be $39\frac{1}{4}$ Inches from the End of the Loop to the Middle of the Plummert, and the Plummert caused to swing; each of those Swings will be a true Second of Time, always counting every Time it passes the Perpendicular let fall from the Pin, and every Time it passes from the Perpendicular to the utmost Swing will be a Half Second.

How to correct the Distance given by the Log-Line and Half-Minute Glass.

The Distance given by the Log may be wrong on three Accounts, viz. by an Error in the Glass, an Error in the Log Line, or an Error in both; for correcting of which take the following Cases.

C A S E I.

When the Log-Line is truly divided, and the Glass is faulty.

RULE. Say, as the Seconds run by the Glass are to 30 Seconds, so is the Distance given by the Log to the true Distance.

E X A M P L E I.

Suppose a Ship runs at the Rate of $7\frac{1}{2}$ Knots in the Time the Glass runs out, but measuring the Glass I find it runs 34 Seconds, what is the true Rate of Sailing?

As $34 : 30 :: 7.5 : 6.6$ Miles, the true Distance sailed in an Hour.

E X A M P L E II.

Suppose a Ship runs at the Rate of $6\frac{1}{4}$ Knots, but measuring the Glass I find it runs only 25 Seconds; required the true Rate of Sailing?

As $25 : 30 :: 6.5 : 7.8$ Miles, the true Distance sailed in an Hour.

C A S E II.

When the Glass is true and Log-Line faulty.

RULE. Say, as 50 Feet is to the Distance measured between Knot and Knot, so is the Distance run by the Log to the true Distance.

E X A M P L E I.

Suppose a Ship runs at the Rate of $6\frac{1}{4}$ Knots in Half a Minute, but measuring the Space between Knot and Knot, I find it to be 56 Feet; required the true Rate of Sailing?

As $50 : 56 :: 6.25 : 7$ Miles, the true Distance sailed in an Hour.

E X A M P L E II.

Suppose a Ship runs at the Rate of $6\frac{1}{2}$ Knots in Half a Minute, but measuring the Space between Knot and Knot, I find it to be only 44 Feet; required the true Rate of Sailing?

As $50 : 44 :: 6.5 : 5.72$ Miles, the true Distance sailed in an Hour.

C A S E III.

When both the Log-Line and Glafs are faulty.

RULE. Multiply thrice the measured Length of a Knot by the Distance run by the Log, the Product divided by 5 Times the measured Time of the Glafs, will give the true Distance run.

E X A M P L E.

Suppose a Ship runs 5 Knots of a Log-Line of 45 Feet to a Knot, while a Glafs of 25 Seconds is running out; what is the true Rate of Sailing?

The measured Length of a Knot	—	45
Multiplied by	—	3
		— — —

Gives thrice the measured Length of a Knot	135
Which multiplied by the Distance run per Log.	5
	—

675

And dividing the Product by 5 Times the Time the Glafs runs, that is $5 \times 25 = 125$, the Quotient is 5.4, the Number of Miles the Ship runs per Hour.

This Rule is only a Compound of the two former simple ones, which is contracted a little.

When the Glafs is faulty, the Log-Line may be divided as in the annexed Table, shewing the Length of the Knots of the Log-Line to different Glafes.

Seconds of Glafs.	Length of Knots in Feet.
24	40, 0
25	41, 8
26	43, 4
27	45, 0
28	46, 8
29	48, 4
30	50, 0
31	51, 8
32	53, 4
33	55, 0
34	56, 8
35	58, 4
36	60, 0

The Method of Keeping a Journal at Sea.

BY keeping a Journal, is meant keeping such an Account of the Ship's Way that the Mariner may be able at any Time to ascertain the Latitude and Longitude the Ship is in; it therefore should be the great Concern of every Person who takes upon him the navigating of Ships to remote Parts, to be expert therein, as the Lives and Fortunes of so many Men are committed to his Charge.

When a Ship is bound from one Place to another, which lies so far from her, that she is obliged to go out of Sight of Land for any considerable Time, as from England to Jamaica; at the Time of her leaving Sight of Land, she is said to take her Departure, and that Part of the Land she then leaves, is said to be the Place she takes her Departure from; such as the Land's End, Lizard, &c. and at the Time of taking such Departure, the Captain or Mate generally takes the Bearing and Distance of that Land (according to his Judgment) and sets it down on the Log-board, or in the Log-book, against the Time it was taken, thus, Land's End N. N. E. Dist. 7 Leagues, or Lizard N. by W. Dist. 5 Leagues, &c.

In the same Manner may the Departure from any Place be taken, as may be seen in the first Day's Log of the following Journal, where the Log-book is marked in Columns for Hours, Knots, Fathoms, Courses, Winds, Leeway, Transactions; and under it the Columns for Courses, Distances, Northings, or Southings, Eastings or Westings, the Latitude by Dead Reckoning, Latitude by Observation, Meridian Distance, Difference of Longitude, Longitude in, and in the last, Bearing and Distance of the Land.

Notice must be taken, that in the Column for Course, you are always to set down the Course you have made by your Reckoning for that 24 Hours; that is, from the Noon of the Day before to the Noon of the Day you work on, the Sea Account being always kept from Noon to Noon.

In the Columns for Distance you are to set down the Distance made by your Reckoning for that 24 Hours.

In the Columns of Northing and Southing, you are to set down the Difference of Latitude made in that 24 Hours, marking the Column with North, if the Difference of Latitude be North; and South, if South.

In the Column of Easting or Westing, you are to set down the Departure made that 24 Hours, marking the Column with East, if the Departure be East, and with West, if Westerly.

In the Column marked Latitude by D. R. you are to set down the Latitude you reckon yourself in on that Day; and in the Column
marked

marked Lat. by Obs. you are to set down the Latitude found by Observation ; also the Difference of Longitude made in the 24 Hours in the Column marked Diff. Long. the Longitude in, in the Column marked Long. in ; and in the last, the Bearing and Distance from the Land.

The Variation, if any, must be allowed upon all Courses steered, and upon all Bearings that are taken by the Compass ; that is, if it be Easterly Variation, it must be allowed to the Right Hand, if Westerly to the Left of the Course or Bearing. Supposing yourself placed in the Centre of the Compass, and looking directly forward to the Point you are to allow the Variation upon.

E X A M P L E.

Suppose I steer S. W. and there is one Point Westerly Variation, then my true Course is S. W. by S. or suppose I set a Point of Land, and find it to bear by the Compass E. S. E. and I know here is Half a Point Easterly Variation, then the true Bearing is S. E. by E. $\frac{1}{2}$ E.

Leeway must be allowed upon all Courses steered, which is the Difference between the Point which the Ship endeavours to sail upon, and the Point she really sails upon, and is caused by the Force of the Wind or Surge of the Sea, when she is close hauled or plying to Windward, which makes her fall off and glide sideways from the Point of the Compass she capes at, and must be allowed to be on the Right Hand of the Course steered when the Larboard Tacks are on Board, and to the Left Hand when the Starboard Tacks are on Board. The Allowances that are generally made are as follow :

1st. When a Ship is close hauled, if all her Sails be set, the Water smooth, and a moderate Gale of Wind, she is then supposed to make little or no Leeway.

2dly. The Ship being upon a Wind, and the small Sails in, allow one Point for Leeway.

3dly. The Wind blowing hard, so as to cause one Top sail to be taken in, allow two Points for Leeway.

4thly. When it blows so hard that both Top sails are taken in, and the Sea runs high, allow then three Points for Leeway.

5thly. The Fore sail being furled, and the Ship tries under a Main-sail and Mizzen, allow four Points for Leeway ; for she then makes her Way about four Points before the Beam, as the Sea Phrase is.

6thly. When the Ship tries under the Main-sail only, she then makes her Way about three Points before the Beam, that is, allow near five Points Leeway.

7thly. If

7thly. If the Ship tries under the Mizzen only, her Way is about two Points before the Beam; that is, allow six Points for her Leeway.

8thly. When she lies a Hull, that is, with all her Sails furled, her Way is one Point before the Beam, and then seven Points is her Leeway.

9thly. When a Ship is lying-to under a Main-sail, Mizzen, &c. then observe how she comes up, and falls off, and take the Middle between the two Points, and from that allow the Leeway and Variation.

NOTE. In all Cases, Respect must be had to the Smoothness of the Water, or to the Sea's running high, the Mould and Trim of the Ship, and then the Allowances may be ascertained with the greater Certainty, by setting the Ship's Wake by a Compass placed on each Rail of the Ship's Quarter, which is usually set there for that Purpose.

For it is well known, that some Ships, with the same Quantity of Sail, and with the same Gale, will make more or less Leeway than others; and also the same Ship when she is out of her Trim, or differently loaded, will make different Leeways; for it is observable that the more Water a Ship draws, the less Leeway she makes; because she then meets with a greater Resistance in splitting the Water with her Side, than otherwise she would.

The Leeway may be easily found by the Azimuth Compass, by turning the Instrument about until you see the Wake of the Ship either over the Sights, or parallel to them, then the Point of the Card, which is cut by the vertical Line in the Box, which is nearest to you, is the true Course; the Difference between that and the Course given by the Compass in the Binnacle, is the Leeway required, which ought to be accordingly entered upon the Log-board.

There is another Way of finding the Leeway, by fixing a Compass cut in Lead, or in other Metal, on the Poop, or some other convenient Part of the Ship's Stern, with the Meridian parallel to the Ship's Side, and in the Centre a Pin is fixed, to which is fastened a small Line of a good Length, with a Piece of Wood at the End of it, that it may be dragged after the Ship. The Point or Degree cut by this Line will shew the Leeway; if it cuts the Meridian the Ship makes no Leeway; but if it does not, the Difference between the Meridian and where it cuts is the Leeway.

By some of the above Methods, the Leeway (if there be any) ought to be carefully observed as often as may be judged necessary; and these Observations should be punctually set down by the Officer of the respective Watch; at least, if no Observation be made, he ought to set down the Leeway according to his Judgment once or twice in the Watch, and by this Means the Course made good may be

be found to a much greater Certainty and Exactness than by the common Method of allowing for Leeway, when the Day's Account comes to be worked, (which is generally once in 24 Hours :) For an Observation must certainly be better than any Guess. But if no Observation be made, the Person who is upon Deck, and has the Care of the Watch, is better able to make proper Allowances, while Things are fresh in his Memory, and while he is an Eye Witness of the several Accidents that happen; and certainly much more capable than another who was not upon Deck during the whole Watch,

I have often admired to see how particularly every Thing is stated upon the Log board, excepting the Leeway; and yet that (which is one of the most material Articles, since the Course, according to the Compass must be corrected by it) only allowed for the next Day, according to every one's Fancy, thereby, as it were, keeping as many different Journals as there are Artists (so called) on board the Ship, and yet not one regular Journal properly kept amongst them all, since one of the most material Articles is only-guessed at.

E X A M P L E I.

Suppose I steer N. E. by E. with my larboard Tacks on board, and make one Point Leeway, then my Course made good is E. N. E.

Leeway and Variation, when they are both to be allowed one Way, that is, both to the Right Hand, or both to the Left, add them together, and allow their Sum the same Way they were to be allowed.

But if they are to be allowed, one to the Right Hand, and the other to the Left, subtract the less from the greater, and allow the Remainder the same Way the greater was to be allowed.

E X A M P L E III.

Suppose I steer N. N. W. with my starboard Tacks on board, and make one Point Leeway, there being at the Time Half a Point Westerly Variation; I would know my true Course?

Leeway to the left Hand	1 Point.
Variation to ditto	$\frac{1}{2}$ Point.

Their Sum to be allowed to the left Hand	1 $\frac{1}{2}$ whence
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The true Course is N. W. by N. $\frac{1}{2}$ W.

E X A M P L E

E X A M P L E III.

Suppose I steer S. W. by W. with my larboard Tacks on board, and make two Points and an half Leeway, and I have one Point and a quarter Westerly Variation, what is my true Course?

Leeway to the right Hand	2 $\frac{1}{2}$ Points.
Variation to the left Hand	1 $\frac{1}{4}$ Point.

The Remain. to be allowed to the right Hand 1 $\frac{1}{4}$ whence

The true Course is W. S. W. $\frac{1}{4}$ Westerly.

E X A M P L E IV.

Suppose a Ship lying-to under a Main-sail, with her starboard Tacks on board, comes up E. by S. and falls off to N. E. by E. there being one Point Westerly Variation, and she makes 5 Points Leeway, what Course does she make good?

The Middle between E. by S. and N. E. by E. is E. by N. for which allowing 6 Points to the left Hand, the true Course will be N. by E.

It is plain, by the preceding Examples, that if the Leeway is made towards the Meridian, it is taken from the Course steered; but when it is made from the Meridian, it must add to the Course steered, to find the true Course. The same may be observed of the Sum or Difference of the Leeway and Variation, as may be seen by the following Table, which is here set down to exercise the young Navigator in the foregoing Rules.

The T A B L E.

Courses steered.	Winds.	Lee- way.	Varia- tion.	Courses corrected.
N. W. $\frac{1}{2}$ W. W. W. S. W. W. W. by N. S. W.	N. N. E. N. N. W. S. S. S. W. N. by W. W. N. W.	$\frac{1}{2}$ $\frac{3}{4}$ 1 $\frac{3}{4}$ $1\frac{1}{4}$ $1\frac{1}{2}$	$\frac{3}{4}$	N. $5\frac{3}{4}$ W. S. $6\frac{1}{2}$ W. S. $6\frac{1}{4}$ W. W. S. 7 W. S. $1\frac{3}{4}$ W.
S. S. S. W. S. W. W. W. by N. S. E. by S E. N. E. E. E.	W. S. W. W. N. W. by W. S. S. W. N. by W. E. S. E. S. $\frac{1}{2}$ E. N. N. S. S. E.	$\frac{3}{4}$ 1 $\frac{1}{2}$ $1\frac{3}{4}$ 1 2 $\frac{3}{4}$ $1\frac{3}{4}$ $\frac{3}{4}$ 0	$1\frac{1}{4}$ W.	S. S. E. S. $\frac{1}{4}$ E. S. S. W. $\frac{1}{4}$ W. W. by N. $\frac{1}{2}$ W. W. S. W. $\frac{3}{4}$ W. S. $\frac{3}{4}$ W. E. by N. E. N. E. $\frac{1}{2}$ E. E. by N. $\frac{1}{2}$ E. E. N. E. $\frac{3}{4}$ E.
S. E. S. E. W. S. W. W. by N. N. W.	E. S. E. N. E. S. S. W. by S. W. S. W.	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{3}{4}$ 1 1	$1\frac{3}{4}$ W.	S. by E. $\frac{1}{4}$ E. E. by S. $\frac{1}{4}$ E. S. W. by W. W. $\frac{1}{4}$ N. N. W. $\frac{3}{4}$ W.
S. N. by E. N. W. by N. N. W. by W. W. by S.	W. S. W. N. W. by W. W. by S. N. by E. N. W. by N.	1 $\frac{3}{4}$ $1\frac{1}{4}$ $1\frac{1}{2}$ $1\frac{3}{4}$	$0\frac{3}{4}$ E	S. $\frac{1}{4}$ E. N. N. E. $\frac{3}{4}$ E. N. $\frac{3}{4}$ W. N. W. by W. $\frac{1}{4}$ W. W. $\frac{1}{2}$ S.

NOTE. In sailing in the Channel, or along a Coast in a Tide or Current, particular Care must be taken to take its Setting for a Course, and its Drift for a Distance, which must be entered among the Courses and Distances in the Table of that Day's Reckoning. And where the Setting of the Tide and Drift are not known, you must attain the Point it must set upon, both of the Flood and Ebb, from the Chart of the Coast you are Sailing along, by the Times of High Water at different Places on the Coast, and by the Principles of Fluid acting against such Rocks, Shoals, Sand Banks, &c. By a strict Regard to these, both the Drift and Setting of the Tides may be pretty nearly ascertained and allowed for.

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Currents, the Way they set you, and the Distance you suppose you are driven by them, is to be set in the Traverse Table for the Day, as any other Course and Distance.

E X A M P L E V.

Suppose I try the Current, and find it to set W. by N. per Compass one Mile per Hour, the Variation being one Point Easterly; then if I sail in that Current 24 Hours, I set down in the Table as a Course, W. N. W. Distance 24 Miles.

Heave of the Sea is to be accounted for in the same Manner as Currents: As, suppose there is a great Sea heaving towards the S. W. by my Compass, there being Half a Point Westerly Variation, I then set down in my Traverse Table S. W. by S. half Westerly, with so much Distance as I judge the Sea has heaved the Ship.

At leaving the Land, the opposite Point to the Bearing, with the Variation allowed upon it, and the Distance you judge yourself from it, must be set down in the Traverse Table as a Course and Distance.

E X A M P L E VI.

Suppose having one and a quarter Point Westerly Variation, the Start bearing by my Compass N. N. E. distant four Leagues; the opposite Point to N. N. E. is S. S. W. which, with the Variation, makes S. $\frac{3}{4}$ Westerly, for the Course to be set in the Traverse Table distant 12 Miles.

When you make the Land your Bearing, itself (with the Variation allowed upon it) and the Distance you judge yourself from it, is to be set down in the Traverse Table as a Course and Distance. This needs no Example.

The Courses marked on the Log-board are the Courses steered by the Compass. In order to obtain the true Course, it is necessary to allow both for the Variation of the Compass, and for the Leeway upon each Course on the Log-board, as has been shewn, before they are put into the Traverse Table.

Every Day, at Noon, the Log-board is to be transcribed into the Log-book, which is ruled exactly like the Log-board.

Mariners reckon by the civil Account of Time used on Shore, but they keep the Reckoning for the Ship's Place, by beginning at Noon, and counting from thence 24 Hours to the next Noon. From Noon to Midnight they mark with P. M. signifying after Mid-day; and the second 12 Hours with A. M. signifying after Midnight, ending their Day's Work at the Noon of the civil Day. Hence their Ship's Account is 12 Hours earlier than their Shore Account of Time. And as the Sun's Declination used for finally deter-

determining the Ship's Place at the End of the Sea Day is calculated for the Noon of the common Day at London or Greenwich, therefore the Declination for the Noon of the civil Day, must be taken for determining the Latitude, &c. at finishing their Day's Account. Thus a Day's Work marked Tuesday, May the 6th, began on Monday at Noon, and ends on Tuesday Noon, so that the Sun's Declination for the 6th of May is used for the Noon of Tuesday, and fitted to the Meridian of the Ship, according as she is E. or W. of London.

There are various Methods of keeping a Sea Journal, according to the Sentiments of various Persons with Regard to what deserves being recorded: Some approve of a Journal including the Log-book, each Day's Work at some Length, and such Occurrences as seem of most Importance; while others prefer a short Abstract of this long Journal, containing little more than the Course run, the Latitude and Longitude in, and sometimes the Bearing and Distance of the intended Port for each Day.

In the following Journal the long Form is used as representing more fully each Day's Work, and the necessary Corrections; and an Abstract of this may be drawn out in the shortest Form that seems consistent with Distinctness. The Learner ought to be thoroughly acquainted with the long Form, and when he does that, he may either continue it, or take the shortest Form; or retrenching from the first, and adding to the second, what Particulars he thinks proper, and thereby make out a Form adapted to his own particular Taste.

RULES for correcting the DEAD RECKONING by an Observation.

NOTWITHSTANDING the Rules already laid down for keeping a Ship's Way at Sea, yet by Reason of the several Accidents that may attend a Ship in one Day's Run, such as swelling Seas, different Rates of sailing between the Times of heaving the Log, want of Care at the Helm in letting the Ship yaw or fall off, accidental Currents, sudden Squalls, when no Account can be kept &c. the Latitude by Account and Latitude by Observation may very often differ, then it is necessary that proper Corrections be made in the Difference of Longitude.

When you have made all proper Allowances you can, such as for Leeway, Variation, Currents, &c. and still find that your Latitude by Account will not agree with your Latitude by Observation, then you must correct as follows:

First,

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First, Consider whether you have made proper Allowances for Currents, Heave of the Sea, if the Course at the Helm has been carefully attended to, if the Log-line and Half-minute Glass be just, and the Log properly hove, or any sudden Squalls, or proper Allowances made for the Leeway, &c. which of these you conjecture your Error is in; make what Allowances you think meet to your Difference of Latitude and Departure by Dead Reckoning, and see if that will reform your Latitude by Account, so as to make it agree with your Latitude by Observation; if it does, you have guessed right; (for you must always keep to the Latitude by Observation, it being the only Thing to be depended on;) but if it will not agree with the observed Latitude, it is to be supposed that there are Mistakes in your Conjecture, or some other Cause which produces the Error in the Reckoning, and stands in need of being corrected. In this Case, you are first to examine your Log-line and Half-minute Glass, and if there be an Error in them, allow for it, as in the following Example.

E X A M P L E I.

Yesterday, at Noon, we were in Lat. $48^{\circ} 20' N.$ and till this Day at Noon we have sailed S. S. W. 48 Miles, S. W. by S. 36 Miles, N. E. 24 Miles, and find by a good Observation that we are in Lat. $47^{\circ} 14' N.$

T R A V E R S E T A B L E.

Courses.	Dist.	N.	S.	E.	W.
S. S. W.	48		44,4		18,4
S. W. by S.	36		29,9		
N. E.	24	17,0		17,0	20,0
		17,0	74,3		38,4
			17,0		17,0
			57,3		21,4

By the Traverse Table it appears that by Account the Diff. of Lat. is 57.3 S. and the Departure 21.4 W.

Now the Lat. left was $48^{\circ} 20' N.$
Diff. of Lat. by Account $0 \quad 57 \text{ S.}$

Latitude in by Account $47 \quad 23 \text{ N.}$

Differing 9 Miles from the true Latitude by Observation.

Wherefore

Wherefore I examine the Log-line and Half-minute Glass, and find that the former measures 52 Feet between Knot and Knot, and that the latter runs only 27 Seconds. Now as the Log-line and Half-minute Glass are both faulty, I correct my Difference of Latitude and Departure as in Case III. and find my correct Difference of Latitude 66.2 S. and my Departure 24.7 W.

Now from Latitude left	48° 20' N.
Take Diff. corrected for Error in Dist.	1 6 S.
Lat. in, corrected for Error in Dist.	47 14 N.

Agreeing exactly with my Latitude by Observation: I therefore conclude my Reckoning sufficiently correct. Then with the Difference of Latitude 66.2, and Departure 24.7, together with Yesterday's Latitude, I find the Difference of Longitude either by Middle Latitude or Mercator's Sailing.

In the last Example 57.3 and 21.4, multiplied severally by 156, thrice the measured Length of a Knot, and divide the two Products by 135, five Times the measured Time of the Glass, will give the Difference of Latitude 66.2, and Dep. 24.7, which is the same Thing as if every Course had been corrected separately.

E X A M P L E II.

Yesterday at Noon, we were in Lat. 36° 15' N. and have sailed these 24 Hours S. E. $\frac{1}{2}$ E. 55 Miles, N. E. by N. 20 Miles, W. S. W. 70 Miles, S. by W. $\frac{1}{2}$ W. 20 Miles, and by Observation this Day at Noon we are in Lat. 34° 56' N.

The TRAVERSE TABLE.

Courses.	Dist.	N.	S.	E.	W.
S. E. $\frac{1}{2}$ E.	55		34.9	42.5	
N. E. by N.	20	16.6		11.1	
W. S. W.	70		26.8		64.7
S. by W. $\frac{1}{2}$ W.	20		19.1		5.8
		16.6	80.8	53.6	70.5
			16.6		53.6
			64.2		16.9

By

THE DEAD RECKONING. 191

By the Traverse Table it appears that by Account the Diff. of Lat. is 64.2 S. and the Departure 16.9 W.

Latitude failed from	36° 15' N.
Difference of Latitude by Account	1 4 S.
Latitude in by Account	35 11 N.

Differing 15 Miles from the Latitude by Observation.

I now examine the Log-line and Half minute Glass, and find them both right. Next I consider whether there be any Current, and I think I have Reason to suspect one: Upon Trial I find there is one setting S. S. W. $\frac{3}{4}$ W. at the Rate of 7 Fathoms an Hour, and judge I have been in it these 24 Hours. Then 7 Fathoms (or Tenths of a Knot) per Hour, in 24 Hours, makes about 17 Miles; and to the Dist. 17 Miles, and Course S. S. W. $\frac{3}{4}$ W. the Diff. of Lat is 14.6 S. and Departure 8.7 W.

	Diff. Lat.	Dep.	
Now by Tra. Table	64.2 S.	16.9 W.	Latitude failed from 36° 15' N.
And by Current	14.6 S.	8.7 W.	Diff. of Lat. cor. for Cur. 1 19 S.
Correct for Cur.	<u>78.8 S.</u>	<u>25 6</u>	Lat. in correct for Cur. <u>34 56</u>

Which agreeing with my Latitude by Observation, I conclude that my Reckoning is Right; then having the Latitude left, and Latitude come to, the Difference of Longitude may be found either by Middle Latitude or Mercator's Sailing as before.

If after all proper Allowances are made for Errors in Distance, Currents, &c. the Latitude by Account and observed Latitude should disagree, then the Reckoning must yet be further corrected; to do which, the following are the common, and seem to be the most rational Methods.

C A S E I.

If the Course found by Dead Reckoning be less than 3 Points or 33 Degrees.

RULE. To the Difference of Latitude and Departure by Account find a Course; to this Course and the Difference of Latitude by Observation, find the Difference of Longitude, either by Middle Latitude or Mercator's Sailing.

E X A M P L E

E X A M P L E.

Yesterday, at Noon, we were in Lat. $39^{\circ} 18' N.$ by an Observation, this Noon we are in Lat. $37^{\circ} 48' N.$ and our Dead Reckoning gives 107 Miles of Southing, and 64 of Westing; required the true Difference of Longitude?

To the Difference of Latitude 107, and Departure 64, I find the Course $2\frac{3}{4}$ Points; then with Meridional Difference of Latitude between the two Observations 115, and the same Course, I find the true Difference of Longitude 69 Miles.

C A S E II.

If the Course found by Dead Reckoning be more than 3 Points, or 33° , and less than 5 Points, or 56° .

RULE. With the Diff. of Lat. and Dep. by Account, find the Distance; with this Distance, and the Diff. of Lat. by Observation, find another Departure. Take half the Sum of this Dep. and Dep. by Account, for the true Dep. with which and the Diff. of Lat. by Observation, find the Diff. of Long.

E X A M P L E.

Yesterday, at Noon, we were in Lat. $52^{\circ} 40' N.$ and are this Noon in Lat. $54^{\circ} 22' N.$ having by Account made 84 Miles of Northing and 76 Miles of Westing; required the true Difference of Longitude?

To the Diff. of Lat. 84, and Dep. 76, the Distance is 113 Miles, and the Course 42°

To Dist. 113, and Diff. of Lat. between the two Observations 102, the Dep. is 47.7; then 76 added to 47.7, is 123.7, half of which is 61.8, the true Dep.

To Dep. 61.8, and Diff. of Lat. by Observation 102, the Course is 31° , and with the Course 31° , and the Meridional Diff. of Lat. between the two Observations 171, I find the Diff. of Long. is 103 Miles.

C A S E III.

If the Course by Dead Reckoning be more than 5 Points, or 56° .

RULE. With the Diff. of Lat. and Departure by Account find the Distance; then with this Dist. and Diff. of Lat. by Observation find the Diff. of Long.

E X A M P L E

E X A M P L E.

Yesterday at Noon we were in Lat. $38^{\circ} 52' N.$ to-day at Noon we are in Lat. $40^{\circ} 18' N.$ and by Account have made 68 Miles of Northing, and 112 Miles of Westing; required the true Difference of Longitude?

With the Diff. of Lat. 68, and Depar. 112, I find the Dist. 132 Miles, and to Distance 132, and Diff. of Lat. by Observation 86, the Course $49^{\circ} 30'$ nearly; with this Course, and the Meridional Diff. of Lat. between the two Observations 111, the Diff. of Long. is 130 Miles.

The Reason of the above Rules is plain, if we consider, that when a Ship sails near the Meridian it will require a sensible Error in the Course to make any considerable Error in the Difference of Latitude; which can hardly happen if proper Care is taken at the Helm; and therefore it is most likely that the Error is in the Distance run; but when the Course is near the Middle of the Quadrant, or between 3 and 5 Points from the Meridian, it is then probable the Error may be in both the Course and Distance; and when the Course is more than five Points from the Meridian, it is then most likely the Error is in the Course, as it will require a great Error in the Distance to make any considerable one in the Difference of Latitude.

NOTE. As the true Place of a Ship depends upon her Lat. and Long. being truly ascertained, I have set these down only, the rest being of less Consequence to the Mariner.

To correct for several Days.

By Help of the three preceding Rules, the Long. may always be corrected for a single Day, but if an Observation has been wanted for one or more Days, then mark the Lat. and Long. at last Observation, or if this be your first Observation since leaving the Land, mark the Lat. and Long. of the Land you left; this is the only Lat. and Long. you can call certain; all the following Part of the Reckoning must undergo a Correction, which is made as follows:

Take the Northings, Southings, Eastings, and Westings, that you have made since your last Observation; or if it be your first Observation, then for every Day from your leaving the Land, minding not to leave out the Diff. of Lat. and Dep. of the Day you correct on, and bring them into a Traverse Table, by which you will have the whole Diff. of Lat. and Dep. by Account since the last Observation; and with that same Diff. of Lat. and Dep. find the Course

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by dead Reckoning, then observe which of the foregoing Cases that Course falls under, and correct by the Rule for that Case. But when an Observation has been wanting for several Days, then mark the Latitude and Longitude you were in at your last Observation, or leaving the Land as before, and then you may correct with a greater Degree of Certainty; especially in High Latitudes, by the following Rules.

C A S E I.

Reckoning from the last certain Latitude and Longitude.

When the Course given by the Meridional Diff. of Lat. and Diff. of Long. by Account, taken as Diff. of Lat. and Dep. is less than 3 Points, or 33 Degrees.

RULE. To the Mer. Diff. of Lat. and Diff. of Long. by Account (taken as Diff. of Lat. and Dep. as shewn in the Mercator's Sailing) find a Course, with this Course and the Merid. Diff. of Lat. by Observation, find a corresponding Dep. which will be the correct Diff. of Long.

E X A M P L E I.

Having sailed three Days ago from Lat. $49^{\circ} 57' N.$ and got no Observation till this Day at Noon, and find I am in Lat. $45^{\circ} 23' N.$ and by Dead Reckoning I am in $45^{\circ} 12' N.$ having differed my Long. 173 Miles, required my true Difference of Longitude?

M. Parts.			M. Parts.		
Lat. sailed from	49 57 N.	3470	Lat. sailed from	49 57	3470
Lat. by Account	45 12 N.	3047	Lat. by Obser.	45 23	3063
Merid. Diff. of Lat. by Acc.	423		Mer. Diff. of Lat. by Obs.	407	

To Merid. Diff. of Lat. by Acc. 423, and Diff. of Long. by Acc. 173, the Course is $22^{\circ} 15'$. Then with the Course $22^{\circ} 15'$, and Meridional Diff. of Lat. between the Observations 407, I find the Diff. of Long. is 167 Miles.

C A S E

C A S E II.

When the Course given by the Meridional Diff. of Lat. and Diff. of Long. by Account (taken as before) is greater than 3 Points, and less than 5 Points.

RULE. To the Merid. Diff. of Lat. and Diff. of Long. by Account, taken as Diff. of Lat. and Dep. find a Distance; with this Distance, and Merid. Diff. of Lat. by Observation, find a corresponding Departure; Half the Sum of this Dep. and the Diff. of Long. by Account, is the correct Diff. of Longitude.

E X A M P L E II.

Three Days ago we were in Lat. $45^{\circ} 23' N.$ and have since that Time sailed between South and West, have by Dead Reckoning altered our Lat. 94 Miles, and our Long. 147 Miles: but by an Observation this Day, we find we are in Lat. $43^{\circ} 34'$; required the correct Diff. of Long.

	M. Parts.		M. Parts.
Lat. sailed from $45^{\circ} 23' N.$	3063	Lat. sailed from $45^{\circ} 23'$	3063
Lat. by Acc. 43 49 N.	2931	Lat. by Obs. 43 34	2910
Mer. Diff. of Lat. by Acc.	132	Mer. Diff. by Obser.	153

With the Merid. Diff. of Lat. by Acc. 132, and Diff. of Long. by Acc. 147, I find the Distance 198, and Course 48° . Then to Distance 198, and Merid. Diff. of Lat. by Observation 153, the Dep. is 125; now 125 added to 147 is 272, and half this Sum, viz. 136, is the correct Diff. of Long.

C A S E III.

When the Course given by the Mer. Diff. of Lat. and Diff. of Long. by Acc. (taken as before) is more than 5 Points or 56 Degrees.

RULE. To the Merid. Diff. of Lat. and Diff. of Long. by Acc. taken as Diff. of Lat. and Dep. find a Distance.

To this Distance and Merid. Diff. of Lat. by Observation find a corresponding Dep. this Dep. will be the correct Diff. of Long.

E X A M P L E III.

Two Days ago I was in Lat. $43^{\circ} 34' N.$ and have since then made by Acc. 50 Miles of Southing, and 256 Miles Diff. of Long. West, but find by Observation that I am in $42^{\circ} 30' N.$ what is my true Diff. of Long.

	M. Parts.		M. Parts.
Lat. failed from $43^{\circ} 34' N.$	2910	Lat. failed from $43^{\circ} 34'$	2910
Lat. by Acc. $42^{\circ} 44' N.$	2841	Lat. by Obser. $42^{\circ} 30'$	2822
Mer. Diff. of Lat. by Acc.	69	Mer. Diff. of Lat. by Obser.	88

Then to Merid. Diff. of Lat. by Acc. 69, and Diff. of Long: by Acc. 256 (taken as Diff. of Lat. and Dep.) the Distance is 265, and Course 75 Degrees.

And to Distance 265, and Diff. of Lat. 88 (the Merid. Diff. of Lat. by Observation) the Dep. is 250, which is the correct Diff. of Long.

Here we have given at some Length the different Methods of correcting the Dead Reckoning by an Observation, which are readily done by the Table of Diff. of Lat. and Dep.

The Ship's Way is generally greater than the Distance given by the Log, and it is always safest to have the Reckoning a-head of the Ship, that the Mariner may be looking out for Land, and not make it before he is aware of it.

When a great Sea sets after the Ship, it is common to allow one Mile over for every ten given by the Log, for the Heave of the Sea; but if the Sea be against or athwart her, her Distance must be less than that given by the Log.

The Error in the Ship's Reckoning is frequently attributed to unknown Currents; for by various Causes yet undetermined, there are many counter Motions of the Water in the open Seas, as well as those observed near the Shores, where the Motions may be tolerably well accounted for. Some of the observed Currents in the great Seas may perhaps be owing to the Tides following the Moon, and to the libratory Motion the Waters may have thereby, and the unsettled Setting and Drift of these Currents, may possibly depend on the Change in the Moon's Declination. However, it is well known from Observations, that the Trade Winds occasion a considerable Current within their Limits, particularly within the Torrid Zone, where the Motion is perpetually towards the West, at the Rate of 8 or 10 Miles a Day, but at the Extremities of the Trade Winds, or near the Latitudes of $30^{\circ} N.$ or $S.$ it is likely that

that the Currents are compounded of the said Western Motion, and of one towards the Equator; therefore, all Ships sailing within these Limits should allow a Course each Day for this Current.

NOTE. When the Difference of Latitude by Account is less than the Difference of Latitude by Observation, the Ship is a-head of the Reckoning, but if less, the Reckoning is a-head of the Ship.

When the Mariner is dubious of his Account of Longitude, he generally runs into the Latitude of the intended Port, and then sails E. or W. if there be Sea Room, according as it is situated, and keeps a good look out for the Land.

The Method I have chosen to introduce the young Mariner into the most capital Part of Navigation is, by shewing him first how to work a few separate Day's Work independent of each other, and then proceed to a continual Journal from London to Madeira, and back again to England, in which will be inserted most of the Occurrences that commonly happen at Sea, or in Harbour.

I have seen many young Navigators who have been taught the Principles of Navigation on Shore, very deficient in keeping a Journal at Sea; and, therefore, must request the Teacher not to omit putting the Pupils over the following Journal, which will render them ready at Working a Day's Work at Sea, and confirm in their Memory those Rules they have been over.

E X A M P L E

RULES FOR KEEPING A JOURNAL.

E X A M P L E I.

Yesterday at Noon we were in the Latitude of $46^{\circ} 28' N$. Longitude $22^{\circ} 18' W$. and have sailed till this Day Noon, as by the Log-Board, the Tide having all the Time set S. by E. $2\frac{1}{2}$ Miles per Hour: Required the Ship's Place and the direct Course and Distance made good?

LOG-BOARD.						TRAVERSE TABLE.					
H	K	F	Courses.	Winds.	Lee-way.	Courses.	Dist.	N.	S.	E.	W.
1	6	3	N. N. E.	W.		N. N. E.	31	28.6		11.9	
2	6	2				E. N. E.	35	13.4		32.3	
3	6	5				E. by S.	36		7.0	35.3	
4	6	4				S. S. E.	51		47.1	19.5	
5	6	0				S. by E.	60		58.8	11.7	
6	6	1	E. N. E.	N. W.							
7	6	6					42.0	112.9		110.7	Dep
8	5	8						42.0			
9	5	6									
10	5	4									
11	5	5									
12	5	3	E. by S.	N.							
1	5	9									
2	6	2									
3	6	0									
4	6	3									
5	6	4									
6	7	0	S. S. E.								
7	6	8									
8	7	3									
9	7	5									
10	7	1									
11	7	9									
12	7	3									

Dep. Lat.— $46^{\circ} 28' N$	M. Par.—3156
Diff. Lat.—1 11 S.	
Pref. Lat.— $45^{\circ} 47' N$	M. Par.—3054
Sum Lat.— $91^{\circ} 45'$	Mer. D. Lat.—102
Mid. Lat.— $45^{\circ} 52'$	
Co. M. Lat.— $44^{\circ} 08'$	
Dep. Long.— $22.18 W$.	
Diff. of Long. $2.39 E$. or $2^{\circ} 40'$	
Pref. Long.— $19.39 W$.	
Direct Course— $S. 57^{\circ} 22' E$.	
Distance — 131 Miles.	

The Courses and Winds on the Log-Board being examined, it appears that the Ship goes large, and has no Lee-way; therefore the several Courses from the Log-Board are entered in the Traverse Table without Alteration.

Next the Fathoms and Knots belonging to each Course are summed up, and the Results are put in the Column of Distances in the Traverse Table; and to these Courses and Distances, the whole Difference of Latitude and Departure are found.

Then having the Latitude left, and the Latitude come to; find the Complement of Middle Latitude, and with that, and the Departure, find the Course, &c. by Middle Latitude Sailing.

Or with the Meridional Difference of Latitude find the Course and Difference of Longitude, by Mercator's Sailing.

NOTE. When the odd Fathoms are above five, we allow one Knot, but if under five, nothing is allowed.

E X A M-

E X A M P L E II.

Being Yesterday Noon in Latitude $25^{\circ} 30' S.$ and Longitude $10^{\circ} 15' E.$ we have sailed till this Day Noon, as per Log-board, in a Current setting South $2 \frac{1}{2}$ Miles an Hour, the Variation $1 \frac{1}{2}$ Point West: Required the Ship's Place?

LOG-BOARD.						TRAVERSE TABLE.					
H	K	F	Courses.	Winds.	L. Way	Courses.	Dist.	N.	S.	E.	W.
1	6	0	S. W.	W. N. W.	1	S. by W. $\frac{1}{2}$ W.	30		28.7		8.7
2	6	2				S. by E. $\frac{1}{2}$ E.	32		30.6	9.3	
3	6	4				S. $\frac{1}{2}$ E.	30		29.9	2.9	
4	6	0				SE. by E. $\frac{1}{2}$ E.	39		18.4	34.4	
5	5	3				S. by E. $\frac{1}{2}$ E.	60		57.4	17.4	
6	6	0	S. by W.	W. by S.	1	Diff. Lat.					
7	5	1							165.0	64.0	8.7
8	5	4								8.7	
9	5	2									
10	5	3								55.3	Dep
11	5	5	S. S. W.	W.	1	Diff. Lat. — $2^{\circ} 45' S.$					
12	5	2				Dep. Lat. — $25^{\circ} 30' S.$ Mer. Parts 1583					
1	5	2				Pref. Lat. — $28^{\circ} 15' S.$ Mer. Parts 1768					
2	5	0				Sum Lat. — $53^{\circ} 45'$ M. Diff. Lat. 185					
3	4	6				Mid. Lat. — $26^{\circ} 52'$					
4	5	0	S. E. by S.	S. W. by S.	1	Co. M. Lat. $63^{\circ} 08'$					
5	5	1				Long. left. — $10^{\circ} 15' E.$					
6	5	2				Dif. Long. — $1^{\circ} 02' E.$ or $1^{\circ} 01' \frac{1}{2} E.$					
7	5	4				Pref. Long. — $11^{\circ} 17' E.$					
8	5	4				Course is S. $18^{\circ} 30' E.$					
9	6	0				Distance 174 Miles.					
10	6	0									
11	5	4									
12	5	5									

The Courses and Winds on the Log-board being examined, it appears that the Ship is closed hauled on each Tack, and one Point Leeway being allowed, reduces the Courses, and taking a Course for the Current S. these several Courses being corrected by the Variation $1 \frac{1}{2}$ Point West, give those in the Traverse Table, to which the whole Difference of Latitude and Departure is to be found as above.

And hence the present Latitude and Longitude may be found, either by Middle Latitude or Mercator's Sailing; for as the Ship is near the Equator, the Difference will be almost insensible.

E X A M.

RULES FOR KEEPING A JOURNAL.

E X A M P L E III.

Yesterday at Noon we were in Latitude $33^{\circ} 40'$ N. Longitude $16^{\circ} 20'$ West, the Sun was observed to set $50^{\circ} 18'$ from the North Point of the Compass; we have failed this Day Noon, as per Log-Board, in a Current setting W. S. W. $1\frac{1}{2}$ Mile per Hour: Required the Ship's Place, and her Course and Distance to the West End of the Island of Madeira?

LOG-BOARD.						TRAVERSE TABLE.					
H	K	F	Courses.	Winds	L. Way	Courses.	Diff.	N.	S.	E.	W.
1	6	2	S. by W.	W.	0	S. 01 °E.	40		40,0	0.7	
2	6	0				S. 10 W.	70		68,9		12,2
3	6	3				S. 44 W.	58		41,7		40,3
4	7	0				S. 54 W.	36		20,6		29,5
5	7	2				Diff. Lat.					
6	7	3							171.2	0.7	82,0
7	7	2	S.W byS.	W byN	1						0,7
8	7	2									
9	7	4								Dep.	81,3
10	7	6				Before the Courses can be corrected to put into the Traverse Table, the Variation of the Compass must be found from the Sun's true Amplitude. The Declination is 22° 30' N. As Cos. 33° 40' : Rad. :: Sin. 22° 30' : Sin. 27° 22' So that the true Amplitude = 62° 38' W. Mag. Amplitude = 50 18 W. Variation = 12 20 W. The Courses on the Log-Board being corrected by this Variation and the Lee-way, will give the Courses fitted for the Traverse Table.					
11	7	4									
12	8	1									
1	8	0									
2	8	5									
3	8	2									
4	7	5	S.W byW	N. W.	0						
5	7	3									
6	6	6									
7	6	4									
8	6	0									
9	6	2									
10	6	1									
11	6	3									
12	6	1									

Dep. Lat.	— $33^{\circ} 40'$ N.	Madeira's Lat.	— $32^{\circ} 30'$ N.	Mer. Parts	2064
Diff. Lat.	— 2 51 S.	Pref. Lat.	— $30^{\circ} 49'$ N.		1945
Pref. Lat.	— $30^{\circ} 49'$ N.	Diff. Lat.	— 1 41		119
Sum Lat.	64 29	Sum Lat.	— 63 15		
Mid. Lat.	— 32 14	Mid. Lat.	— 31 37		
Co. Mid. Lat.	— 57 45 N.	Co. Mid. Lat.	— 58 23		
Dep. Long.	— $16^{\circ} 20'$ W.	Madeira's Long.	17 26 W.		
Diff. Long.	— 1 36 W.	Pref. Long.	— 17 56 W.		
Pref. Long.	— 17 56 W.	Diff. Long.	— 0 30 W.		
		The Course N.	14 30 E.	Diff.	104 Miles.

In the Work for the Amplitude, the Latitude at Sun-set was taken the same as at Noon; for although there were about 46 Miles of Southing in that Time, and so the Latitude at Sun-set was about $32^{\circ} 54'$ yet the Amplitude being only about $15'$ less, the Alteration in Variation would scarcely affect the Difference of Latitude and Departure found from the Courses so corrected.

E X A M P L E

RULES FOR KEEPING A JOURNAL

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EXAMPLE IV.

Yesterday at Noon we were in Latitude $19^{\circ} 30' S.$ and Longitude $0^{\circ} 10' E.$ This Forenoon we observed the Sun's Altitude to be $10^{\circ} 40'$ when he was $80^{\circ} 30'$ from the North Point of the Compass; we have sailed till this Day Noon, as per Log-Board in a Current setting by the Compass W. N. W. $\frac{1}{2}$ a Mile an Hour. Required the Ship's Place and her direct Course and Distance to the Island of St. Helena.

LOG-BOARD.						TRAVERSE TABLE.					
H	K	F	Courses.	Winds.	Lec-Way	Courses.	Dist.	N.	S.	E.	W.
1	6	7	N. by E.	E. by N.	I	N. 13° W.	38	37.0			8.5
2	6	2				N. 25° W.	39	35.3			16.5
3	6	4				N. 47° W.	76	51.8			55.6
4	6	3				N. 81° W.	12	1.9			11.9
5	6	1									
6	6	0						126.0	Diff. Lat.	Dep.	92.5
7	5	8	North.	E. N. E.	I						
8	5	4									
9	5	0									
10	5	3									
11	5	6									
12	5	9									
1	5	7									
2	6	4	N. N. W.	N. E.	I						
3	6	8									
4	7	0									
5	7	3									
6	7	6									
7	7	5									
8	7	0									
9	7	2									
10	7	4									
11	6	3									
12	6	0									

Diff. Lat.	$2^{\circ} 06' N.$	Mer. Parts.	True Azimuth from	$113^{\circ} 00'$	the South
Lat. left	$19^{\circ} 30' S.$	1193		$180^{\circ} 00'$	
Lat. in	$17^{\circ} 24' S.$	1060	True Azimuth from	$67^{\circ} 00'$	E. the North
Sum Lat.	$2)36^{\circ} 54'$	Mer. Diff. Lat. 133	Mag. Azimuth	$N. 80^{\circ} 30' E.$	
Mid. Lat.	$18^{\circ} 27'$		Variation	$13^{\circ} 30' W.$	
	$90^{\circ} 00'$		Lat. in	$17^{\circ} 24' S.$	Long. in
Com. Mid. Lat.	$71^{\circ} 33'$		St. Hel. Lat.	$16^{\circ} 04' S.$	St. Hel. Lon.
Longitude left	$00^{\circ} 10' E.$		Diff. Lat.	$1^{\circ} 20'$	Diff. Long
Diff. Long.	$1^{\circ} 38' W.$			$60'$	$60'$
Present Longitude	$1^{\circ} 23' W.$		In Miles	80	In Miles
					266

With the Meridional Difference of Latitude and Difference of Longitude, the direct Course to St. Helena is found N. $72^{\circ} 40' W.$ and with that Course and the proper Difference of Latitude the Distance is found 269 Miles.

In this Example the Azimuth is worked with Yesterday's Latitude and Declination, but had it been worked with this Day's, the Variation would have been $12^{\circ} 26' W.$

A
JOURNAL of a VOYAGE

FROM

LONDON to MADEIRA,

In the NANCY, of London, A. B. Commander, kept by
T. WEIR, Mate.

Departure taken from the Lizard in Lat. $49^{\circ} 57' N$. Long. $5^{\circ} 14' W$.
Bound for Funchal, in Madeira, in Lat. $32^{\circ} 38' N$. Long. $17^{\circ} 6' W$.
Bearing from the Lizard Point S. $27^{\circ} 1' W$. Distance 1156 Miles.

In the following Journal are exemplified the Manner of allowing for
the Variation, Leeway, Lying-to, Calms, Currents, Heave of the Sea,
&c. and to correct the Dead Reckoning by an Observation in all Cases,
with most of the Occurrences that commonly happen at Sea.

Wednesday April 23d.	At 5 A.M. the Pilot came on Board ; then weighed and sailed from Tower Wharf. At 11 came to with the Best Bower at Blackwall. Wind S. S. W.
Thursday 24th.	Fresh Gales and cloudy Weather, with Rain. At 5 A.M. weighed and sailed ; at 9 came to an Anchor at Gravesend, and cleared Ship. Wind from S. S. W. to N. N. W.
Friday 25th	At 4 P.M. weighed and sailed, moderate Weather ; at 9 came to with the Best Bower at the Nore in $9\frac{1}{2}$ Fathoms, fresh Gales ; at 4 A. M. weighed and sailed ; at 11 came to Anchor in the Downs in 7 Fathoms, Deal Castle bearing W. $\frac{1}{2}$ S. distant 3 Miles. Wind W. by S.
Saturday 26th.	At 1 P. M. sent the Pilot on Shore. These 24 Hours, the first and middle Parts moderate and fair, the latter Part strong Gales and cloudy.
Sunday 27th.	Strong Gales and cloudy. At 2 P. M. veered out the Long Service of the Best Bower, got Top-gallant Yards down. At 4 P. M. struck Yards and Top-masts. These 24 Hours had very hard Gales of Wind. Wind W. by S.
Monday 28th	These 24 Hours for the most Part fresh Gales. At 4 A. M. hove up the Best Bower, and let go the small Bower. At 9 hove up the small Bower, and let go the Best Bower again. People employed in making Points and Gaskets.
Tuesday 29th	At 6 P. M. Strong Gales with heavy Rain. At 8 veered out the Long Service, and let go the Sheet Anchor under Foot. At 9 A. M. hove up the Sheet Anchor. Wind variable from S. by W. to W.
Wednesday 30th.	These 24 Hours, for the first and middle Part moderate and fair, the latter Part strong Gales. Wind W. by S.
Thursday May 1st.	These 24 Hours fresh Gales and fair. At 3 P. M. got Top-gallant Mast down ; at 10 A. M. got Yards and Top-mast up. Wind E. S. E.

NOTE. All Cables ought to be 120 Fathoms in Length, and are in Proportion to each other as the Cubes of their Diameters. The Number of Threads of which a Cable is composed being always proportioned to the Length and Thickness, and the Weight and Value of it is determined by this Number. The Number of Threads and Weight of Cables of different Circumferences may be seen in the following Table :

Circumference in Inches.	9	10	11	12	13	14	Threads or Rope Yarns.	393	485	598	699	821	952	Weight in Pounds	1572	1940	2394	2796	3284	3808
Circumference in Inches.	15	16	17	18	19	20	Threads or Rope Yarns.	1095	1244	1404	1574	1754	1943	Weight in Pounds	4372	4976	5616	6295	7016	7772

H.	K.	F.	Courses.	Winds.	Lee-way	REMARKS on Board, Friday, May 2d.
2			S. by W. $\frac{1}{4}$ W.	N. $\frac{1}{2}$ W.		At 2 P. M. hove short.
4						At 4 weighed and failed in Co. with a 40
6						Gun Man of War, and 20 Sail of
8						Merchantmen.
10			W.	N. by W.		At 6 S. Foreland bore N. N. W. dist. 4 M.
12			S.W. by W. $\frac{1}{4}$ W.			At 2 A. M. Fairlee bore N. dist. 6 M.
2						At 6 Beachy bore N. by W. 6 Miles
4			W. N. W. $\frac{1}{2}$ W.	N. $\frac{1}{2}$ W.		At 8 Beachy bore N. E. by E. 9 Miles.
6			W. S. W.	N. by E.		Fresh Gales and clear, several Ships stand-
8						ing up Channel; close reefed both Top-
10						fails.
12						At 12 Bembridge Pt. bore W. N. W. 27 M.
						Still in Company with the Fleet.
H.	K.	F.	Courses	Winds.	Lee-way.	REMARKS on Board, Saturday, May 3d.
2	4	0	W. S. W.	N. by E.		
4	4	6	W. $\frac{3}{4}$ S.			
6	5	5				Fresh Gales and clear.
8	5	0				At 4 P. M. parted with the Fleet, they
10	5	1				being bound to Spithead. Dunnose
12	4	6				bearing W. N. W. distant 21 Miles.
2	5	0				At 5 let out one Reef of each Top-sail.
4	4	4				At 7 A. M. Portland Light bore W. N.
6	4	5				W. 9 Miles
8	4	0				At 10 A. M. it bore N. E. 12 Miles, 14
10	4	2	S. by W. $\frac{1}{2}$ W.	N. N. E.		Sail in Sight.
12	5	0				

Being upon the Coast this last Day, the Log is hove, and the Bearings and Distances of Lands, Rocks, Sands, &c. as you approach them must always be set down, and are of the greatest Consequence, especially in bad Weather, or when you are in Danger of being drove out of your true Course, in the Night, or in a Fog; so that you may at any Time determine, by your Reckoning, or the Chart, the Ship's Place, and sail Courses and Distances as Circumstances require, in order to pass Places of Danger, and to have it always in your Power to take your Departure from some known Place, in Case you should be drove out to Sea in the Night or in foggy Weather, when no Land can be seen. For it sometimes happens, that in working to Windward in the English Channel, E. of Dunnose, Ships, by making too long a Board, have got upon a Sand called the Ower, which lies from Dunnose E. $\frac{1}{4}$ N. 25 Miles. It is therefore absolutely necessary to have good Draughts of the Coasts you sail upon, unless you are well acquainted with them indeed.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on Board, Sunday, May 17th, 1783.
2						These 24 Hours moderate Gales, and fair Weather.
4						
6						
8	4		S. W. by W.	N. E.		At 6 P. M. the Lizard bore N. by E. Distance
10	4	5				6 Leagues, from which I take my Depart. it
12	5					being in the Lat. of $49^{\circ} 57'$ N. and Long.
2	5					$5^{\circ} 14'$ West of London.
4	5	5	S. W.			Unbent the Cables and stowed the Anchor.
6	5	5				Several Sail in Sight, standing to Westward.
8	5	5				
10	5	5				
12	6					Variation $1 \frac{1}{2}$ Point Westerly.

Courfe.	Diff.	S.	W	Lat. by D. R.	Lat. by Ob.	Mer. Diff.	Diff. Lon.	Long. in.	Bearing and Dist.
S 26 30 W	107	56	48	48. 21 N.		$0^{\circ} 48'$	$1^{\circ} 14'$	$0^{\circ} 28' W.$	Uinant N. 8 30 E. 54 M.

The Lizard bearing N. by E. Dist. 6 Leagues from the Ship is the same as if the Ship had sailed from the Lizard 6 Leagues or 18 Miles upon the opposite, or S. by W. Point of the Compass, and allowing for the Variation, as before taught, makes it S. half E. Dist. 18 M. which is to be set down as the first Course and Distance in the following Traverse Table.

The first Course steered by Compass is S. W. by W. which, allowing for the Variation, makes S. W. by S. half W. and the Sum of all the Distances sailed on that Course till two o'Clock, when it alters, is 18 Miles and an half, which being doubled, because the Log. is heaved every two Hours, gives 37 Miles; so the second Course and Dist. to be set down in the Traverse Table is S. W. by S. half W. 37 Miles. In like Manner the second Course steered is S. W. and the Variation allowed makes it S. S. W. half W. and the Dist. on that Course summed up and doubled, gives 56 Miles; therefore the third Course and Distance to be set down in the Traverse Table is S. S. W. half W. 56 Miles. Having found the whole Difference of Latitude and Departure made upon the several Courses, I then mark down upon my Slate or Paper what every Thing that is to be found comes to, and afterwards set them down in their proper Columns as above.

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
S. $\frac{1}{2}$ E.	18		17.9	1.8	
S. W. by S. $\frac{1}{2}$ W.	37		28.6		23.5
S. S. W. $\frac{1}{2}$ W.	56		49.4		26.4
			95.9		49.9
				1.8	
					48.1

Now to Diff. of Lat. 95.9 S. and Dep. 48.1 W. the Course is S. $26^{\circ} 30' W.$ Dist. 107 Miles; then Lat. sailed from, or Lizard's Lat. $49^{\circ} 57' N.$
 Diff. of Lat. $1^{\circ} 36' S.$
 Lat. in, or Ship's Lat. $48^{\circ} 21' N.$
 Sum of Lats. $98^{\circ} 18'$
 Middle Lat. $49^{\circ} 09'$
 Com. of Middle Lat. $40^{\circ} 51'$
 Then with this Com. of Mid. Lat. $40^{\circ} 51'$, or 41° found as a Course among the Degrees, and the Dep. 48.1 in its Column, in the Dist. Col. stands 74, which is the Diff. of Long.

Or, with the Course $26^{\circ} 30'$ and Meridional Diff. of Lat. 147, the Diff. of Long. is found to be nearly 74 by Mercator's Sailing.

Longitude sailed from, or Lizard's Longitude	$5^{\circ} 14' W.$	} This being the first Day since leaving the Land, the Departure is the Mer. Dist.
Difference of Longitude 74 Miles	$1^{\circ} 14' W.$	
Longitude in, or Ship's Longitude	$6^{\circ} 28' W.$	

To find the Bearings and Distance of Ushant.

Latitude in	$48^{\circ} 21' N.$	Longitude in	$6^{\circ} 28' W.$	Mer. Parts	3323
Ushant's Lat.	$48^{\circ} 30' N.$	Ushant Long.	$5^{\circ} 5' W.$	Mer. Parts	3337
Difference of Lat.	9	Diff. Longitude	1 23	Mer. Diff. of Lat.	14

With the Mer. Diff. Lat. and Diff. Long. Ushant is found to bear N. $80^{\circ} 26' E.$ and with that Bearing, taken as a Course, and the proper Difference of Latitude the Distance is found 54 Miles.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS on Board Monday, May 12th, 1783.			
2	6		S. W. by W.	N.		Thefe 24 Hours moderate Gales and Cloudy Weather. At 4 P. M. Spoke the Charming Nancy, from Carolina, bound to London.			
4	5	5		N. W.					
6	5								
8	5								
10	3	6	S. W.						
12	3	4				At 6 A. M. got the Bower Anchors on the Gun-nell, and unbent the Cables and ftowed them. Variation 1 $\frac{1}{2}$ Point Wefterly.			
2	3	4							
4	4	5							
6	4	6							
8	5		S. W. by S.	W. N. W.					
10	4	5							
12	4								
Course.	Diff.	Lats.	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Distance	Diff. Longitude	Long. in.	Bearings and Diff.
S. 30° W	108	93 S.	53 W.	46.48		1° 41' W.	1° 19' W.	7° 47' W.	C. Cre gal S. 30° E Distance 181 M.

The Variation being allowed on each Course, and the Distances summed up, as before taught, the Traverse Table will stand thus :

With the Difference of Latitude and Departure the Course is found S. 30° 0' W. and the Distance 108 Miles.

Diff. of Latitude $1^{\circ} 33' S.$ Mer. Parts. 3323
Latitude left $45^{\circ} 21' N.$

Lat. in $46^{\circ} 48' N.$ 3185

Sum Lat. $95^{\circ} 09'$ Mer. Diff. Lat. 138

Middle Lat. $47^{\circ} 34'$
 $90^{\circ} 00'$

Com. Mid. Lat. $42^{\circ} 26'$

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
S. W. by S. $\frac{1}{2}$ W.	43		33.2		27.3
S. S. W. $\frac{1}{2}$ W.	39		34.4		18.4
S. by W. $\frac{1}{2}$ W.	27		25.8		7.8
		Diff. Lat.	93.4	Dep.	53.5

The Diff. of Long. is found by Mercator's, or Middle Latitude Sailing to be $1^{\circ} 19' W.$
Yesterday's Longitude $6^{\circ} 28' W.$

Longitude in $7^{\circ} 47' W.$

This Day's Departure being added to the Mer. Distance Yesterday, gives $1^{\circ} 41'$ the Mer. Distance to Day.

To find the Bearings and Distance of Cape Ortgal.

Latitude in $46^{\circ} 48' N.$ Longitude in $7^{\circ} 47' W.$ Mer. Parts 3185
Cape's Latitude $43^{\circ} 47' N.$ Cape's Longitude $7^{\circ} 34' W.$ Mer. Parts 2928

Diff. Latitude $3^{\circ} 01'$ Diff. Longitude $13'$ Mer. Diff. of Lat. 257
 60

In Miles 181

With the Meridional Difference of Latitude and Difference of Longitude, the direct Course to Cape Ortgal is S. 30° E. and with that Course and the proper Difference of Latitude, the Distance is 181 Miles.

NOTE. As the Table of Difference of Latitude and Departure are only calculated to single Degrees, the nearest Degree to the Com. of Middle Latitude is to be taken in working by Inspection to find the Difference of Longitude by, which is near enough for all common Purposes at Sea ; thus, the Comp. of Mid. Latitude is $42^{\circ} 26'$, for which I take 42° to find the Difference of Longitude. The same may be observed in finding the Course made good, the nearest Degree or $\frac{1}{2}$ Degree to the Course is always set down, and will be found sufficiently exact.

The Variation in the Channel is now almost 24° , and as this is only a supposed Journal, it is immaterial what Variation is set down.

FROM LONDON TO MADEIRA:

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H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Tuesday, May 13th, 1783.			
2	4		S. W.	W. N. W.	0	These 24 Hours moderate Gales and clear Weather.			
4	4					At 6 P. M. saw a Ship to the Westward.			
6	4								
8	4	4	S. W. by S.	W. by N.	$\frac{1}{2}$	Observed the Sun's Merid. Alt. at Noon $61^{\circ} 40'$			
10	4	5							
12	4	6							
2	4	5	S. S. W.	West	1	Zenith Distance $28^{\circ} 28'$ S.			
4	4					Declination $17^{\circ} 03'$ N.			
6	4								
8	4					Latitude $45^{\circ} 23'$ N.			
10	4								
12	4					Variation $1^{\circ} \frac{1}{2}$ Point Westerly.			
Courfe.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Diff.	Diff. Long.	Long. in.	Bearings and Distance.	
S. $80^{\circ} 30'$ W.	97	96	14	45. 12	45. 23	$1^{\circ} 53'$	00 21	S. 01	Cape Ortegal S. by E. Distant 98 Miles.

By allowing for Variation and Leeway the Work will be as follows.

With the Diff. of Lat. and Dep. the Courfe is found S. $82^{\circ} 30'$ W. and the Distance 97 Miles.

Diff. Lat. $1^{\circ} 36'$ S. Mer. Parts. 3185
Latitude left 46 $48'$ N. 3047

Lat. in by D. R. 45 12 Mer. Diff. Lat. 138

Sum Lat. 92 00

Middle Lat. 46 00
90 00

Comp. Mid. Lat. 44 00

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
S. S. W. $\frac{1}{2}$ W.	24		21. 2		11. 3
S. by W.	36		35. 3		7. 0
S. $\frac{1}{2}$ E.	40		39. 8	3. 9	
	Diff. Lat.		96. 3	3. 9	18. 3
					3. 9
				Dep.	14. 4

Longitude left $7^{\circ} 47'$ W.
Diff. Long. 21 W.

Longitude in by Account 8 08

Here the Latitude by Observation differing from the Latitude by Account, I correct for the true Longitude; and as this is the first Observation got since leaving the Land, I correct by Case I. as follows:

Lizard's Lat. $49^{\circ} 57'$ N. Mer. Parts 3470
Lat. by D. R. 45 12 N. Mer. Parts 3047

Mer. Diff. Lat by Account 423

Lizard's Longitude $5^{\circ} 14'$ W.
Long. in by Account 8 8 W.

Diff. of Long. by Account 2 54
60

In Miles 174

Lizard's Lat. $49^{\circ} 57'$ N. Mer. Parts 3470
Obs. Lat. 45 23 N. Mer. Parts 3063

Mer. Diff. Lat. by Observation 407

With the Mer. Diff. of Lat. and Diff. Long. by Account, the Ship's direct Course from the Lizard is found to be S. $22^{\circ} 22'$ W. or S. S. W.

With that Course, and the Mer. Diff. of Lat. by Observation, the Diff. of Long. since leaving the Lizard is found 167 Miles equal to $2^{\circ} 47'$ W.

Lizard's Longitude $5^{\circ} 14'$ W.

Longitude in 8 01

With the Course $22^{\circ} 22'$ or 2 Points, the proper Diff. of Lat. 274 Miles, the true Mer. Diff. is found 113 Miles.

To find the direct Course and Distance to Cape Ortegal.

Lat. in $45^{\circ} 23'$ N. Long. in $8^{\circ} 01'$ W. Mer. Parts 3063
Cape's Lat. 43 47 N. Cape's Longitude 7 34 W. Mer. Parts 2928

Diff. Lat. 1 36 Diff. Longitude 27 135

With the Mer. Diff. of Lat. and Diff. of Long. the direct Course to Cape Ortegal is found S. by E. and with that Course and the proper Diff. of Lat. 96, the Distance is found to be 98 Miles.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS ON Board Wednesday, May 14th, 1783.			
2	3	5	S. by W. $\frac{3}{4}$ W.	West	I	Thefe 24 Hours moderate Gales and clear Weather. At 8 P. M. fet up the Mizzen Top-Maft Shrouds and Back-Stays.			
4	3	5							
6	3	5							
8	3								
10	3	5							
12	3		S. by W.	W. by S.	I	Variation $1\frac{1}{4}$ Point Wefterly, per Amplitude.			
2	3								
4	3								
6	3								
8	3								
10	3								
12	3								
Courfe.	Diff.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Diff.	Diff. of Long.	Long. in.	Bearings and Distance
S. 9° E.	76	75 S.	12 E.	44.08		1.41	17 E.	$7^{\circ} 44' W.$	C. Ortegál S. $19^{\circ} 00'$ Diftant 22 Miles

With the Difference of Latitude and Departure the Course is found S. 9° E. and the Distance 76 Miles.

Diff. Lat. $1^{\circ} 15' S.$ Mer. Parts.

Yesterday's Lat. 45 23 N. 3063

Latitude in 44 08 N. 2957

Sum Lat. 89 31 106

Middle Latitude 44 45
90 00

Comp. Mid. Lat. 45 15

TRAVERSE TABLE					
Courses.	Diff.	N.	S.	E.	W.
S. $\frac{1}{2}$ E.	46		45.8	4.5	
S. by E. $\frac{1}{2}$ E.	30		29.1	7.3	
	Diff. Lat.	74.9	11.8	Dep.	

Yesterday's Longitude $8^{\circ} 01' W.$

Diff. Longitude 0 17 E.

Longitude in $7^{\circ} 44' W.$

This Day's Departure being subtracted from the Meridional Distance of Yesterday, gives $1^{\circ} 41'$ the Meridional Distance of To-day.

To find the Bearings and Distance of Cape Ortegál.

Latitude in	44 ⁰ 08' N.	Longitude in	7 ⁰ 44' W.	Mer. Parts	2957
Cape's Lat.	43 47 N.	Cape's Longitude	7 34 W.	Mer. Parts	2928
Diff. Lat.	21	Diff. Longitude	10	Mer. Diff. Lat.	29

With the Mer. Difference of Latitude and Difference of Longitude Cape Ortegál is found to bear S. $19^{\circ} 0' E.$ and with that Bearing taken as a Course, and the proper Difference of Latitude, the Distance is found 22 Miles.

NOTE. When the Tenths on any Side are more than 5, or half a Mile, you must call that Side one more than you found it to be; but when they are less than 5, then you need take no Notice of them; as in the above the Difference of Latitude and Departure are 74.9 and 11.8, which I call 75 and 12, because the Tenths are above 5.

But when you take the Difference of Latitude and Departure to find the Course by, then take them in Miles and Tenths, the same may be observed in casting up the Knots and Fathoms.

If, when doubled, the Tenths are more than 5, set one Mile more in the Traverse Table; but if less, omit them, as there are no Tenths in the Distance Column.

					REMARKS on Board, Thursday May 15 1783.					
H.	K.	F.	Courfes.	Winds.	Lee-way.					
2	3	5	Weft	S. S. W.	3	Thefe 24 Hours hard Gales and fqually with fmall Rain—Handed the Fore and Main Courfes.				
4	3	5			5	At 8 P. M. faw a Ship to Windward with Jury Mafts up.				
6	3	5								
8	Lay too, up N. W. by N. off N. by E.			5						
10	Drift 1½ Mile per Hour. W.									
12										
2	Up N. W. off North W. by S.			S. W.	N. W. by W. ½ W.	5	Set the Courfes clofe reefed—more moderate.			
4	Drift 1 ½ Mile per Hour					½				
6										
8	5			Set the Top-fails clofe reefed.						
10	5					Variation 1 ¼ Point Wefterly.				
12	5									
Courfe.	Diff.	Lat.	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Diff.	Diff. of Long.	Long. in	Bearings and Diſtance	
S 81° 30 W	25	4	25	44° 04'		2.6	36	8 20 W.	C. Finiſterre S. 47° W. Diſtance 75 Miles.	

Taking the Middle Points (viz. N. by W. and N. N. W.) between the Point to which the Ship comes up to, and the Point she fell off too for the second and third Courses, as taught in the Rules for lying too, see Page 173, and then allowing as before for Variation and Leeway, the Traverse Table will stand as follows :

With the Diff. of Lat. and Dep. the Course is found S. $81^{\circ} 21' W$. and the Distance 25 Miles.

Diff. of Lat. $00^{\circ} 04' S$. Mer. Parts.

Yesterday's Lat. $44^{\circ} 08' N$. 2957

Lat. in $44^{\circ} 04' N$. 2951

Sum Lat. $88^{\circ} 12'$ Mer. Diff. Lat. 6

Middle Latitude $44^{\circ} 06'$
 $90^{\circ} 00'$

Comp. Mid. Lat. $45^{\circ} 54'$

TRAVERSE TABLE.					
Courses.	Diff.	N.	S.	E.	W.
W. N. W. $\frac{1}{4} W$.	21	7.1			19.8
N. N. E. $\frac{1}{4} E$.	9	7.7		4.6	
N. by E. $\frac{1}{4} E$.	9	8.5		3.0	
S. S. W. $\frac{1}{4} W$.	30		27.1		12.8
		23.3	27.1	7.6	32.6
			25.3		7.6
	Diff. Lat.	3.8	Dep.	25.0	

The Departure to Day being added to the Mer. Diff. Yesterday, gives $2^{\circ} 6'$, the Mer. Diff. to Day.

With the Course and Mer. Diff. of Lat. the Diff. of Long. is found by Mercator to be 39 Miles. Or, with the Mid. Lat. and Dep. the Diff. of Long. is found by Mid. Lat. Sailing $36^{\circ} W$.
Yesterday's Longitude $7^{\circ} 44' W$.

Longitude in $8^{\circ} 20' W$.

Here the Diff. of Long. found by Mid. Lat. differs considerably from that found by Mercator's Sailing, but if the Mer. Parts were taken from a Table of Miles and Tenths it would agree nearer with Mid. Lat. Sailing; but in all Cases where the Course is so great, and the Difference of Latitude is in Miles and Tenths, Middle Latitude should be depended on.

To find the Bearings and Distance of Cape Finifterre.

Latitude in	$44^{\circ} 04' N$.	Longitude in	$8^{\circ} 20' W$.	Mer. Parts	2951
Cape's Latitude	$43^{\circ} 13' N$.	Cape's Long.	$9^{\circ} 26' W$.	Mer. Parts	2881
Diff. Latitude	51	Diff. Long.	1 06	Mer. Diff. of Lat.	70

With the Mer. Diff. of Lat. and Diff. of Long. Cape Finifterre is found to bear S. $47' W$. and with that Bearing and the proper Diff. of Lat. the Distance is found 75 Miles.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS ON Board, Friday May 16th, 1783.			
2				Calm.		The first eight Hours calm and foggy.			
4									
6									
8									
10	3	5	W. S. W.	South	1	Fresh Gales and clear.			
12	4	4							
2	4	6							
4	4	8							
6	4	6							
8	4	8				A Current setting N. W. by N. 1 Mile per Hour all Day.			
10	4	8				Variation 1 $\frac{1}{4}$ Point Westerly.			
12	4	5							
Courfe.	Diff.	Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Diff.	Diff. Lon.	Long. in.	Bearings and Distance.
S. 79° 57' W. or 80°	84	15	83	43.49	43.34	3.19	1.55	10.2	Cape Finisterre S. 51° E. Distant 33 Miles

The Variation and Lee-way being allowed on the Course steered, and the setting of the Current and its Drift in 24 Hours being made a Course and Distance, the Work will be as follows:

With the Diff. of Lat. and Dep. the Course is found S. $79^{\circ} 57' W.$ and the Distance 84 Miles.

Diff. Lat. $00^{\circ} 15' S.$ Mer. Parts.

Lat. left 44 4 N. 2951

Lat. in 43 49 N. 2931

Sum of Lats. 87 53 Mer. Diff. of Lat. 20

Mid. Lat. 43 56
90 00

Com. Mid. Lat. 46 04

The Diff. of Long. found by Mercator's Sailing is 113 Miles, but by Mid. Lat. it is found 115 Miles, equal to $1^{\circ} 55' W.$

Longitude left 8 19 W.

Longitude in by Account 10 14 W.

The Diff. of Long. found by Mid. Lat. still differs from that found by Mercator's Sailing; the Cause is the same as before, and as the Ship has made so great a Course we will still depend on Mid. Lat.

The Lat. by Observation differing from the Lat. by Account, I correct for the true Longitude as follows, it being three Days since I had an Observation before.—See Case II. Page 195.

Mer. Parts.
Last Obs. Lat. $45^{\circ} 23' N.$ 3063

Ship's Lat. by Acc. $43^{\circ} 49' N.$ 2931

Mer. Diff. Lat. by Account 132

Ship's Long. at last Obs. $8^{\circ} 1' W.$

Ship's Long. by Account to Day 10 14 W.

Diff. Long. since last Obs. 2 13

Last Obs. Lat. $45^{\circ} 23' N.$ 3063

Ship's Lat. by Obs. $43^{\circ} 34' N.$ 2910

Mer. Diff. Lat. by Obs. 153

The Course found since last Observation $45^{\circ} 13'$ is of no farther Use than to know what Case to correct by.

With the true Course since last Obs. $38^{\circ} 20'$ and the proper Diff. of Lat. 109, the Dep. is $1^{\circ} 26' = 1^{\circ} 53' + 3^{\circ} 19'$

To find the Bearings and Distance of Cape Finisterre.

Latitude in $43^{\circ} 34' N.$ Longitude in $10^{\circ} 02' W.$ Mer. Parts 2910
Cape's Latitude 43 13 N. Cape's Longitude 9 26 W. Mer. Parts 2831

Diff. Lat. 21 Diff. Longitude 36 Mer. Diff. of Lat. 29

With the Mer. Diff. of Lat. and Diff. of Long. the direct Course to Cape Finisterre is found S. $51^{\circ} 9' E.$ and with that Course and proper Diff. of Lat. the Distance is found 35 Miles.

TRAVERSE TABLE.

Courses.	Diff.	N.	S.	E.	W.
N. W. $\frac{1}{2}$ W.	24	16.1			17.8
S. W. by W. $\frac{3}{4}$ W.	72		30.8		65.1
		16.1	30.8	Dep.	82.9
			16.1		
					Diff. Lat. 14.7

					REMARKS on Board, Saturday May 17th, 1783.					
H.	K.	F.	Courses.	Winds.						
2	4	5	W. S. W.	South	These 24 Hours moderate Gales, with small Showers of Rain.					
4	4	5								
6	4	5								
8	4									
10	4									
12	4		S. W. by W.	S. by E.	A great Swell from the S. W. for which I allow 6 Miles. Variation 1 Point Westerly per Azimuth.					
2	3	5								
4	3	5								
6	3	5								
8	3									
10	3									
12	3									
Course.		Dist.	Diff. Lat.	Dep	Lat. by D. R.	Lat. by Obf.	Mer. Dist.	Diff. Lon.	Long. in	Bearings and Distance.
S. 53 30 W.		84	50	67	42. 44		4. 26	1 33	11. 35	Funchall S. 23° W. Distant 668 Miles.

In this Day's Work the Swell is considered as a Current, whose Drift in 24 Hours is 6 Miles, the Allowance made for the Swell; and as it comes from the S. W. it heaves the Ship towards the N. E. and the Variation allowed upon it makes the last Course N. E. by N. as in the Traverse Table.

With the Diff. of Lat. and Dep. the Course is found S. 53° 35' W. and the Distance 84 Miles.

Diff. Lat. 0° 50' S. Mer. Parts.
Latitude left 43 34 N. 2910

Latitude in 42 44 2841

Sum of Lat. 86 18 Mer. Diff. Lat. 69

Mid. Lat. 43 09
90 00

Com. Mid. Lat. 46 51

TRAVERSE TABLE.					
Courses.	Dist.	N.	S.	E.	W.
S. W. by W.	58		32. 2		48. 2
S. W.	32		22. 6		22. 6
N. E. by N.	6	5. 0		3. 3	
		5. 0	54. 8	3. 3	70. 8
			5. 0		3. 3
		Diff. Lat. 40. 8 Dep. 67. 5			

The Departure 67 being added to Yesterday's Mer. Dist. gives 4° 26' the Mer. Dist. this Day.

The Difference of Longitude is found as before to be 1° 33' W.
Yesterday's Longitude 10 2 W.

Longitude in this Day 11 35 W.

To find the Bearings and Distance of Funchal.

Latitude in 42° 44' N. Longitude in 11° 35' W. Mer. Parts 2841
Funchal's Lat. 32 32 N. Funchal's Long. 17 5 W. Mer. Parts 2066

Diff. Lat. 612 = 10 12 Diff. Long. 330 = 5 30 Mer. Diff. Lat. 775

With the Mer. Diff. of Lat. and Diff. Long. Funchal is found to bear S. 23° 4' W. and with that Bearing taken as before, and the proper Diff. of Lat. the Distance is 668 Miles.

To find the Bearing and Distance of the intended Port on Mercator's Chart.

Lay a Ruler across Mercator's Chart, in Lat. 42° 44', and set one Foot of the Compasses on the Meridian of London, and the other in Long. 11° 35' W. lay off that same Distance from the Meridian of London, by the Edge of the Ruler, and that will shew the Ship's Place. Then lay the Ruler over the Ship's Place and Funchal, and take the nearest Distance between the Ruler and the Centre of the Compass, slide one Foot along the Side of the Ruler, and the other Foot will shew the Course to be S. S. W. Again, (keeping the Ruler as before) take from the gradual Parallel the Diff. of Lat. between the Ship and Port (10° 12') in your Compasses, and slide one Foot along the Ruler, holding both Points parallel to the N. and S. Lines, till the other cuts the E. and W. Lines, passing through the Ship's Place; the Distance between where the Point rested, by the Edge of the Ruler, and Funchal being measured upon the graduated Parallel, gives nearly 11°, or 660 Miles for the Distance. In like Manner find the Bearing and Distance of any other Place from the Ship; or take the Distance between Funchal and the Ship in your Compasses, and lay it on the Meridian, nearly in the Parallels of the Ship and Funchal, and that will be the Dist. in Degrees or in Leagues, if the Merid. is marked so.

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H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Sunday May 18th, 1783.			
2	4	5	W. by N.	S. W. by S.		These 24 Hours fresh Gales and clear Weather.			
4	4	5							
6	4	5							
8	5								
10	5								
12	5		W. $\frac{1}{2}$ N.	S. S. W. $\frac{1}{2}$ W.	$\frac{1}{2}$	Variation 1 Point Westerly.			
2	5	5							
4	5	5							
6	5	5							
8	5	5							
10	5	5							
12	4								
Cours.	Diff.	Lat	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Diff.	Diff. Lon.	Long. in	Bearings and Distance
West.	120		120	42 44	42. 30	6. 20	2. 43	14. 12	Funchal, S. 13° W. Distant 612 Miles.

The Variation being allowed on both the Courses, and the Leeway upon the second, it will be found that the Ship has sailed due West these last 24 Hours, and by summing up the Distances her whole Distance is found to be 120 Miles, which is also her Departure; it is evident she has made no Difference of Latitude, therefore her Latitude by Account is the same as Yesterday.

As the Ship has sailed upon a parallel with the Equator, her Difference of Longitude is found by parallel Sailing.

Yesterday's Longitude $2^{\circ} 43' W.$
 $11 \quad 35' W.$

Longitude in by Account $44 \quad 18' W.$

The Latitude by Observation not agreeing with the Latitude by Account, and it being two Days since my last Observation, I correct as follows by Case II. Page 195.

Last Obf. Lat. $43^{\circ} 34'$ Mer. Parts 2910
 Lat. in by Acc. $42 \quad 44$ Mer. Parts 2841
 With the Mer. Diff. of Lat. and Diff. of Lon. by Account, the Course since last Obf. is found to be S. 75° W. and the Distance 266 M.

Mer. Diff. Lat. by Account since last Obf. 69

Long. in at last Obf. $10^{\circ} 02' W.$

Ship's Long. by Account $14 \quad 18' W.$

Diff. Long. by Acc. since last Obf. $4 \quad 16' W.$

Last Obf. Lat. $43^{\circ} 34'$ Mer. Parts 2910

ThisDay's Lat. by Obf. $42^{\circ} 30'$ Mer. Parts 2822

Mer. Diff. Lat. by Obf. since last Obf. 88

With that Distance and the Mer. Diff. of Lat. by Observation the true Diff. of Long. since last Observation is found to be $250 = 4^{\circ} 10' W.$
 Long. in at last Observation $10 \quad 2' W.$

Longitude in $14 \quad 12' W.$

With the Course since last Observation S. 70° 30' W. and the proper Diff. of Lat. 64 Miles, the Departure (or Mer. Dist.) since last Observation is found 182 Miles, equal to

Mer. Dist. at last Obf. $3^{\circ} 01' W.$
 $3 \quad 19' W.$

True Mer. Dist. this Day $6 \quad 20' W.$

To find the Bearings and Distance of Funchal in Madeira.

Latitude in	$42^{\circ} 30' N.$	Longitude in	$14^{\circ} 12' W.$	Mer. Parts	2822
Funchal's Lat.	$32 \quad 32' N.$	Funchal's Long.	$17 \quad 5' W.$	Mer. Parts	2066
Diff. Latitude	$598 = 9 \quad 58$	Diff. Longitude	$2 \quad 53 = 173$	Mer. Diff. Latitude	756

With the Mer. Diff. of Lat. and Diff. of Long. the Bearing of Funchal is found S. $12^{\circ} 53'$ or $13^{\circ} W.$ and with that Bearing taken as before, and the proper Diff. of Lat. the Distance is found 612 Miles.

H.	K.	F.	Courfes.	Winds.	Lee-way.	REMARKS ON Board, Monday May 19th, 1783,
2	8		S. S. W.	N. W. by W,		Stiff Gales, with Showers of Rain.
4	8				From 2 P. M. fair Weather and moderate Gales.	
6	8	5			At 8° 25' 46" took the following Obfervation,	
8	8	5			Watch regulated by the Bright Star in the	
10	8	5			Harp Lyra, the Eye being 18 Feet above the	
12	8	5			Water, Diffance of Moon's fartheft Limb	
2	9	0	S. $\frac{3}{4}$ E.	S. W. by W. $\frac{1}{4}$ W.	$\frac{1}{2}$	from Spica 68° 10' 5"
4	6	0			Altitude of the Moon's lower Limb 24° 18' 40"	
6	5	5			Altitude of Spica ——— 45 13 15	
8	5	5			Moon's Horizontal Parallax ——— 61' 1"	
10	5				Semi-diameter at the reduced Time 16 38 with	
12	5				which the true Diff. is found to be 67 18 42	
						Diff. by the Ephem. at 9h 67° 7' 33 67 7 33
						Diff. at ——— 12 69 02 ——— 6 11 9
						Diff. of Diff. in 3 Hours 1 52 29 ———
						Hence the true Long. is found to be 14° 16' W.
						differing 4 Miles from the Longitude by Account
						Variation 1 Point Westerly per Amplitude.

Course.	Diff.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obf.	Mer. Diff.	Diff Lon.	Long. in.	Bearings and Diffance.
South	170	170		39.46	39.40	6.20		14.12	Funchal S. 18° W. Diftant 450 Miles.

Yesterday's Lat. ——— 42° 30' N.
 Diff. Lat. ——— 2 44 S.
 Lat. in by Account ——— 39 46 N.

TRAVERSE TABLE.					
Courses.	Dist.	N.	S.	E.	W.
S. by W.	118		115.7		23.0
S. S. E. $\frac{1}{4}$ E.	54		48.8	23.1	
		Diff. Lat.	164.5	23.1 23.0	23.0
				0.1	Dep.

Proper Allowances being made for Variation and Lee-way, it appears from the Traverse Table that the Ship has sailed due South 164 $\frac{1}{2}$ Miles, and as she made no Departure, her Longitude in and Mer. Dist. is the same as Yesterday; but as by Observation the Ship is found to be in Lat. 39° 40' N. it is plain she has got 6 Miles a-head of her Reckoning, which 6 Miles being added to the Distance by D. R. gives the true Distance and Difference of Latitude as above.

To find the Bearings and Distance of Funchal.

Latitude in	39° 40' N.	Longitude in	14° 12' W.	Mer. Parts	2597
Funchal's Latitude	32 32 N.	Funchal's Longitude	17 5 W.	Mer. Parts	2066
Diff. Latitude 428	7 8	Diff. Longitude 173	2 53	Mer. Diff. Lat.	531

With the Mer. Diff. Lat. 531, and the Diff. of Long. in Miles 173, the direct Course to Funchal is found S. 18° 3, or 18' W. and with that Course and the proper Diff. of Latitude 428, the Distance is found to be 450 Miles.

Now a parallel of Lat. through 39° 40' on the Variation Chart, cuts the Variation Lines in 11° 15' in Longitude 14° 0 W. which confirms the Longitude by Account.

The Variation Charts might be of great use were they drawn upon a large Scale, and the Lines of Variations well laid down, but as the Variation in most Places is continually altering, it renders them in a few Years useless, I would therefore advise the Mariner to trust more to his Reckoning and Lunar Observations, since the Theory of the Variation is not yet known.

H.	K.	F.	Courses.	Winds.	Lee-way.	REMARKS on Board, Tuesday, May 25.			
2	8		S. S. W. $\frac{3}{4}$ W.	W. by N. $\frac{1}{4}$ W.	$\frac{1}{2}$	Fresh Gales and clear Weather.			
4	8								
6	8	5							
8	8	5							
10	8								
12	8	5							
2	8	4							
4	8	4							
6	8	6							
8	8	6							
10	8	5							
12	8								
						Variation $\frac{1}{4}$ Point Westerly per Azimuth.			
Course.	Diff.	Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Dist.	Diff. Lon.	Long. in.	Bearings and Distance
S. by W. $\frac{1}{2}$ W.	192	184	56	36.29	36.36	7.17	1.11	15.23	Funchal S. 19° W. Distant 258 Miles.

By examining the Log-Board it appears that the Ship has sailed S. S. W. $\frac{3}{4}$ W. 200 Miles.

Latitude left $39^{\circ} 40' N.$

Diff. Latitude $3 \quad 11 \quad S.$

Lat. in by Account $36 \quad 29 \quad N.$

TRAVERSE TABLE.					
Course.	Dist.	N.	S.	E.	W.
S. by W. $\frac{1}{2}$ W.	200	Diff. Lat.	191.0	Dep.	58.0

The Latitude by Observation not agreeing with the Lat. by D. R. I correct as follows by Case I. Page 194.

With the Course one Point and a Half, and the Diff. of Lat. by Obs. 184, the Distance is found to be 192 Miles, and the Departure 56, which, being added to the Mer. Dist. Yesterday $6^{\circ} 21' W.$ gives the Mer. Dist. to Day $7^{\circ} 17' W.$

Yesterday's Latitude	$39^{\circ} 40' N.$	Mer. Parts	2597
This Day's Obs. Lat.	$36 \quad 36 \quad N.$	Mer. Parts	2363
Sum of Latitudes	$76 \quad 16$	Mer. Diff. Lat.	234
Middle Latitude	$38 \quad 8$ $90 \quad 00$		
Comp. Mid. Lat.	$51^{\circ} 52'$		

The Diff. of Long. is found by Mercator or Mid. Lat.	$1^{\circ} 11' W.$
Yesterday's Long.	$14 \quad 12 \quad W.$
Long. in this Day	$15 \quad 23$

To find the Bearings and Distance of Funchal.

Latitude in	$36 \quad 36' N.$	Longitude in	$15^{\circ} 22' W.$	Mer. Parts	2363
Funchal's Lat.	$32 \quad 32 \quad N.$	Funchal's Long.	$17 \quad 05 \quad W.$	Mer. Parts	2066
Diff. Lat. $244 =$	$4 \quad 4$	Diff. of Longitude $103 =$	$1 \quad 43$	Mer. Diff. Lat.	297

With the Mer. Diff. of Lat. and the Diff. of Long. the Bearings of Funchal is found, and with that Bearing and the proper Diff. of Lat. the Distance is found 258 Miles.

H.	K.	F.	Courses	Winds.	Lee-way.	REMARKS on Board, Wednesday, May 21st, 1783.			
2	4	3	W. by S. $\frac{1}{2}$ W.	S. by W. $\frac{1}{2}$ W.	$\frac{1}{2}$	These 24 Hours moderate Weather with Rain. This Day we took the Alt. of Jupiter, who pass- ed the Meridian of Greenwich 16h 32, his Declination being then 19° 58' S. and also the Alt. of the Moon, who passed the Merid. of Greenwich at 16h 29', and took double Alti- tudes of the Sun, and found the greatest Dif- ference of Latitudes between all these Me- thods of finding the Latitude, and that found by the Sun's Meridian Altitude to be only 3 $\frac{1}{2}$ Miles. Variation $\frac{3}{4}$ Pt. W. per equal Alt. of the Sun.			
4	4	5	W. S. W. $\frac{1}{2}$ W.	S. $\frac{1}{2}$ W.	$\frac{1}{2}$				
6	4	7							
8	5	2	W. S. W.	South.	$\frac{1}{2}$				
10	5	3							
12	5	5							
2	5	5	S. W. by W.	S. by E.	$\frac{1}{2}$				
4	5	5							
6	5	4	S. W. by W.	S. by E.	$\frac{1}{2}$				
8	5	1							
10	5	5							
12	4	5							
Cours.	Diff.	Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. ^l Diff.	Diff. Lon.	Long. in.	Bearings and Distance.
S. 65° W.	119	50	108	35.52	35.46	9.05	2.13	17.36	Funchal S. 7° 14' E. Distant 106 Miles.

With the Diff. of Lat. and Dep. the Course is found S. 65° 10' W. and the Distance 118.6 Miles.

Yesterday's Lat.
Diff. Lat.

36° 36' N.
44 S.

Lat. by Acc.

35 52 N.

Yesterday's Lat. 36° 36' N. M. Parts 2363

Obs. Lat. 35 46 N. M. Parts 2301

Diff. Lat. by Obs.

50 M. Diff. Lat. 62

Sum Lats.

72 22

Mid. Lat.

36 11
90 00

Comp. Mid. Lat.

53 49

TRAVERSE TABLE.

Courses.	Diff.	N.	S.	E.	W.
W. by S. $\frac{1}{4}$ W.	27		4.0		26.7
W. S. W. $\frac{1}{4}$ W.	31		10.4		29.2
S. W. by W. $\frac{1}{4}$ W.	43		18.4		33.9
S. W. $\frac{1}{4}$ W.	19		11.3		15.3
		Diff. Lat. 44.1		Dep. 110.1	

The Latitude by Observation not agreeing with the Latitude by Account, I correct as follows, by Case III. Page 195.

With the proper Diff. of Lat. by Obs. 50' and the Distance 118.6 the true Course is found 65° 04' and the Departure 108 Miles nearly.

The Departure 108 being added to the Meridional Distance Yesterday, gives 9° 05' W. the Meridional Distance this Day.

With the Comp. of Mid. Lat. and Dep. or with the Course and Mer. Diff. of Lat. 62' the Diff. of Long. is found by Mid. Lat. or Mercator's Sailing to be 133 Miles = 2° 13' W.

Yesterday's Longitude 15 23' W.

Longitude in 17 36 W.

To find the Bearing and Distance of Funchal in Madeira.

Latitude in	35° 46' N.	Longitude in	17° 36' W.	Mer. Parts	2310
Funchal's Lat.	32 32 N.	Funchal's Long.	17 05 W.	Mer. Parts	2066
Diff. Latitude	3 14	Diff. Longitude	31	Mer. Diff. Lat.	244

With the Mer. Diff. of Lat. 244, and the Diff. of Long. 31', Funchal is found to bear S. 7° 14' E. and with that Bearing (taken as before) and the proper Diff. of Latitude, the Distance is found 106 Miles.

H	K.	F.	Courses.	Winds.	Lee- way	REMARKS on Board, Thursday May 22d.
2	6	6	S. by E. $\frac{1}{2}$ E.	S. W. $\frac{1}{2}$ W.	$\frac{1}{2}$	These 24 Hours moderate Gales and clear Weather.
4	5	8				
6	5	8				
8	5	8				
10	5		S. S. E.	S. W.	$\frac{1}{2}$	
12	5	2				
2	5	3				
4	5	5	S. S. E. $\frac{1}{2}$ E.	S. W. by S. $\frac{1}{2}$ W.	$\frac{1}{2}$	
6	5	5				
8	5	5				
10	5	6	S. E. by S.	S. W. by S.	$\frac{1}{2}$	Variation $\frac{1}{4}$ Point Westerly.
12	5	4				

Course	Diff.	Diff. Lat.	Dep.	Lat. by D. R.	Lat. by Obs.	Mer. Diff.	Diff. Lon.	Long. in.	Bearings and Distance
S. 35° 30' E.	135	110	78	34.01	33.56	7.47	1.35	16.01	Funchal S. 32 3 0 W Distant 96 Miles.

With the Diff. of Lat. and Dep. the Course is found S. 37° 48' E. and the Distance 133 Miles.

Yesterday's Lat. 35° 46' N.
Diff. Latitude 1 45 S.

Lat. by Account 34 01 N.

Obs. Lat. 35° 56' N. M. Parts 2167
Yesterday's Latitude 35 46 N. M. Parts 2301

Prop. Diff. Lat Obs. 1 50 M. Diff. 134

Sum of Lat. 69 41

Middle Latitude 34 51
90 00

Comp. Mid. Lat. 55 09

TRAVERSE TABLE.

Courses.	Diff.	N.	S.	E.	W
S. S. E. $\frac{1}{4}$ E.	48		41.2	24.7	
S. E. by S. $\frac{1}{4}$ E.	31		24.9	18.5	
S. E. by S. $\frac{1}{4}$ E.	33		24.4	22.2	
S. E. $\frac{1}{4}$ E.	22		14.8	16.3	
Diff. Lat. 105.38			81.7	Dep.	

The Latitude by Obs. differing from the Lat. by Account, I correct as follows by Case II. Page 195.

With the Diff. of Lat. 110 and the Distance 133, the Dep. is found to be 75, which being added to the former Dep. 82 gives 157, half this Sum is the true Dep. 78 Miles: With the Diff. of Lat. 110 and the Departure 78, the true Course is found S. 35° 20' E. and the Distance 135 Miles.

The Dep. 78 being subtracted from the Mer. Dist. Yesterday, gives 7° 47' W. the Mer. Dist. this Day.

The Diff. of Long. is found by Mercator, or Mid. Lat. Sailing, to be 1° 35' E.
Yesterday's Longitude 17 36 W.

Longitude in 16° 01' W.

To find the Bearings and Distance of Funchal in Madeira.

Latitude in	33° 56' N.	Longitude in	16° 01' W.	Mer. Parts	21 67
Funchal's Lat.	32 32 N.	Funchal's Long.	17 05 W.	Mer. Parts	20 66
Diff. Lat.	1 24	Diff. of Longitude	1 04	M. Diff. of Lat.	101

With the Mer. Diff. of Lat. and the Diff. of Long. the direct Course to Funchal is found S. 32° 22' W. and with that Course and the proper Diff. of Latitude, the Distance is found 96 Miles.

						REMARKS on Board, Friday, May 23d. 1784.				
H.	K.	F.	Courses.	Winds.	Lee-way.					
2	5	1	S. $\frac{1}{4}$ W.	E. by N.		Moderate Gales and hazy				
4	5					At 6 P. M. more clear, saw Porto Santo				
6	4	9	S. by W. $\frac{3}{4}$ W.	E.		bearing N. W. about 7 or 8 Leagues.				
8	4	5				At 10 P. M. saw Funchal, bearing N. W.				
10	4	4				$\frac{3}{4}$ W. Distance 7 Leagues.				
12	4	8	S. S. W. $\frac{3}{4}$ W.	E. S. E.		Clear Weather				
2	5	2				At 10 P. M. came to Anchor off Funchal,				
4	5	2	S. W. $\frac{3}{4}$ W.	N. E.		the Westermoff Point W. by N. the Loo-				
6	5	1				Rock N. by W. the Brazen Head E. by S.				
8	5					the Deserters from E. to S. E. Distance				
10	4	7				about 9 Leagues				
12						Variation $\frac{3}{4}$ Point.				
Course.		Dist.	S.	W.	Lat. by D. R.	Lat. by Obf.	Mer. Diff.	Diff. Lon.	Long. in.	Bearing and Dist.
S. 32° 30' W.		96	78	54	32° 38'			1.4	17.5	Funchal N. 1 Mil.

The Variation allowed upon the several Courses, and also upon the Bearing of the Land taken at Ten o'Clock being put into a Traverse Table, and the Distance run upon each Course, with the Distance you are from the Land, will give the Distance and Difference of Latitude and Departure as above; with the Complement of the Middle Latitude and Departure, the Difference of Longitude is $64^{\circ} 10' 4''$ which added to $16^{\circ} 1'$ the Longitude in Yesterday at Noon, gives $17^{\circ} 5'$ the Longitude in by Account, and as it agrees with the Longitude of Funchal in the Table, I conclude that my Reckoning is just, and Funchal well laid down.

The Ship's Place in the preceding Journal is pricked off, and the Bearing and Distance at Noon are also found by the Chart, in order to shew the Young Navigator the Method; and may be done with a Black Lead Pencil, which he may either let stand or rub out when he pleases.

It is much easier for Ships to run in than out of an Harbour, owing to the Attraction of the Land, especially when high, as the Canary Islands are.

Sir Isaac Newton has discovered that all Bodies attract each other in proportion to the Quantity of Matter they contain; and that a Body containing a greater Quantity of Matter will attract or draw a Body containing less to it; and that this Law is general throughout the Universe, and that this Attraction becomes Repulsion when Bodies are so far asunder as to be out of the Power of Attraction; by these Laws the Heavenly Bodies keep their several Stations in the Universe.

The above Laws may be easily demonstrated in a Bowl of Water, throwing into it several Pieces of Cork of different Sizes, it will then be found that the larger Pieces will attract the less to them; and when the small Pieces come within the Attraction of the great ones they will be drawn to them with Rapidity, or even Boards in smooth Water will likewise be drawn to the Ship by this power of Attraction, consequently Ships must be drawn toward the Land.

I have only mentioned the above Hints to caution the Mariner not to approach too near Rocks or Shores, though they are steep too in a Calm, for fear of the above Attraction, which is often mistaken for Currents, by those who do not understand the Principles.

There are various Methods of keeping a Journal at Sea, some will have two or three Days Work in one Page, others prefer keeping a small Abstract in the following Manner.

Months, Weeks, Days, 1783.	Course.	Dist.	Lat. by D. R.	Lat. by Obs.	Long in.	Bearing.	Dist. at Noon.
Sunday, May 11.	S. 26 30 W.	107	48° 21' N.		6° 28' W.	Uthant N. 80° 30' E.	54 Miles.
Monday, May 12.	S. 30 E.	108	46 48 W.		7 47 W.	Cape Ortegal 3° E.	181 Miles.
Tuesday, May 13.	S. 8 30 W.	96	45 12 N.	45 23 N.	8 1 W.	Cape Ortegal S. by E.	93 Miles.
Wednesday, May 14.	S. 9° E.	76	44 8 N.		7 44 W.	Cape Ortegal, S. 19 E.	22 Miles.
Thursday, May 15.	S. 81° W.	25	44 4 N.		8 20 W.	Cape Finisterre, S. 47 W.	75 Miles.
Friday, May 16.	S. 80° W.	84	4 49 N.	43 34 N.	10 2 W.	Cape Finisterre, S. 51° E.	33 Miles
Saturday, May 17.	S. 53 30 W.	84	42 44 N.		11 35 W.	Funchall, S. 23° E.	668 Miles.
Sunday, May 18.	West	120	42 44 N.	42 30 N.	14 12 W.	Funchall, S. 13 W.	612 Miles
Monday, May 19.	South.	170	39 46 N.	39 40 N.	14 12 W.	Funchall, S. 18 W.	450 Miles
Tuesday, May 20.	S. by W. 1 1/2 W.	192	36 29 N.	36 36 N.	15 23 W.	Funchall, S. 19 W.	258 Miles.
Wednesday, May 21.	S. 65 W.	119	35 52	35 46	17 36	Funchall, S. 7° 14' E.	196 Miles.
Thursday, May 22.	S. 35 30 E.	135	34 1 N.	33 56 N.	16 1 W.	Funchall, S. 32 30 W.	96 Miles
Friday, May 23.			At 10 A. M. saw Funchall Bearing N. W. 1/4 W. Distant				7 Leagues.

A T A B L E

Of the 'True Course, Distance, and Course to be steered by a Compass which varies 2 Points W. from the Downs, through the British Channel, to Sea. A Ship in the Downs to fail,

True Course.	Course to steer	Dist. Miles.	Bearing and Distance from Capes, Headlands or High-lands, Islands, Rocks, Lighthouses, &c.	Miles
S. S. W.	S. S. W.	8½	S. Foreland by Compass, W. N. W. is W. by the Chart Dist.	2
S. W.	W. S. W.	20	Dungeness, N. N. W. is N. W.	3
S. W. by W. ¼ W.	W. by S. ½ W.	32	Beachyhead, N. N. E. is N.	9
W. S. W. ½ W.	W. ¼ N.	62	Dunholf, N. is N. N. W.	15
			St. Catherine's Point, N. by W. ½ W. is N. W. by W. ½ W.	16
		33	Peverel Point, N. by E. is N. by W.	24
		26	Cape la Hogue, S. W. by S. is S. by W.	26
			Bill of Portland, N. by E. ¼ E. is N. ¼ W.	26
			Alderney I. S. ¼ E. is S. E. ¼ E.	21
			Caskets (Rocks) S. by W. ¾ W. is S. ¼ E.	19
		12	Guernsey I. S. by W. is S. by E.	26
		38	The Start, N. by E. is N. by W.	19
		27	Eddestone Lighthouse, N. N. E. is N.	24
			Ramhead, N. N. E. ½ E. is N. ½ E.	36
		58	The Lizard, N. E. is N. N. E.	30
			Land's End, N. ¼ E. is N. by W. ¾ W.	36
		316½	Ushant I. S. by W. is S. by E.	58

The British Channel 290 Miles from the S. Foreland to the Lizard ; to fail in the fair Way 310.

Note. That Ushant and the Lizard bear N. and S. of each other, Dist. $28\frac{1}{4}$ Leagues, which is 85 Miles $\equiv 1^{\circ} 25'$; but the fair Way of the Channel between these Places, is at one Third of the Width of the Channel from the English Coast, which is in the Lat. $49^{\circ} 30' N.$ If you fail in the Mid. Channel till you make the Start, you will have the Tide to set you towards the French Coast ; for in some Parts it sets S. E. and S. S. E.

The Substance of that Examination, which every Candidate for a Commission in the Navy or East-India Service, must necessarily pass, previous to his Appointment, respecting the Management of a Ship, from her first coming out of Dock to her clearing the Land, with Directions for working a Ship in all difficult Cases at Sea.

Ques. **S** I R, you appear here to be examined in your Abilities, necessary to qualify you for being appointed an Officer in the Ship ———, Captain ———, now bound to ——— in ——— Service—a great Charge. What do you look upon to be your Duty in that Capacity?

A. When I have received my Captain's Command, I am then not only to direct, but likewise to inspect into every Thing relative to such Orders, and see it properly executed accordingly.

Q. When your Ship is out of Dock, what is first to be done?

A. After the proper Officers have examined the Timbers, I would level the Hold, by laying the Kentledge from the Fore-part of the Fore-hatchway to the After-part of the After-hatchway.

Q. If you are taking in Bales, how high would you dunnage, and what part of the Ship most?

A. I would dunnage six Inches, and mostly about the Well and Main hatchway, and the Wake of the Chains and Floor Timbers.

Q. Suppose you have one and a half Foot Water in your Hold, and your Ship heels four Streets down; what Dunnage ought you to have, to preserve the Cargo?

A. Three Feet.

Q. How would you moor your Ship at Gravesend?

A. I would come to with my small Bower, veer the Service into the Hawse, and then hang my best Bower in the Long-boat, and with the Tide drop her a stern; and, when the Cable is taut, let go the Anchor.

Q. You have been in the Downs: how do you moor there?

A. With my best Bower to the S. W. upper Deal-Mill and Deal Castle in one, with the South-Foreland S. W. by S. in eight Fathoms; I would veer away with the last quarter Flood, and moor with the same Bower to the N. E.

Q. Where is the best anchoring in the Downs?

A. Bring upper Deal Church in one with Deal Castle, and anchor in eight or nine Fathoms Water.

Q. What are the Marks for anchoring in the Downs, Deal Castle bearing West?

A. The

A. The South Foreland S. by W. or S. S. W. and Sandown Castle N. W.

Q. How would you unmoor in the Downs with the Wind at North?

A. I would splice my Stream-cable to my small Bower, and veer away at half Ebb, that I might have Time to stow my best Bower, and shorten in my small Bower-cable before the Ship tends to Windward; but as soon as the Tide slack, if I was afraid to trust my Stream-cable, I would veer on my best, and take up my small Bower.

Q. Suppose the Wind northerly, you were in a Ship's Hawse in the Downs?

A. I would wait till the Ship tended to Windward, and heave-to my Anchor as she tended to it.

Q. How would you work the Ship out of the Downs with the Wind southerly.

A. I would come no nearer the Goodwin than thirteen Fathoms Water, nor to the Main than eight, or eight and a half Fathoms; when I come near the Foreland, into no less than ten Fathoms; there is a Shoal off West Castle, fourteen Feet at low Water, bearing E. about two Miles.

Q. If it blows hard in the Downs at S. W. and you part your Cables, what would you do?

A. I would stand out to the Goodwins till I brought the South Foreland Light to S. W. by S. then, keeping in nine Fathoms Water, steer N. N. E. till the North Foreland Light bore W. N. W. when I might safely hawl round for Margate Roads.

Q. How do the Forelands bear to each other?

A. Nearest North and South.

Q. How does the Tide flow in the Downs?

A. By the Shore S. S. E. and in the Offing S. W. by S.

Q. What are the Marks of the Goodwin, by which you are to know when you are clear of them?

A. The Goodwin Sands are two large Quicksands, called the North and South Sands. When upper Deal Mill and Warner Castle are in one, then I am a-breast the South Sand-head; and when the North Foreland bears N. W. by W. I am a-breast the North Sand-head.

Q. Suppose you were riding at Anchor in the Downs, and an express Order came for you to go to the Westward with the Wind at S. W. or S. S. W. at what Time of the Tide would you unmoor?

A. I would unmoor at Half-flood, to be in Readiness to weigh at High-water, and cast her in-shore, (by Reason of the Tide being sooner done in-shore) if Room; if not, I would tack and stand off in ten or eleven Fathom Water, then stand in to the Shore in seven Fathoms, and lay my Top-sails back till my Anchors were stowed.

Q. Is

Q. Is there any Danger in going off the Downs ? In what Water would you stand in Shore, and what Water towards the Goodwins ?

A. Yes ; between Deal and Warner Castle there are some Shoals with, at Spring-tides, not above sixteen or seventeen Feet Water at Low-water. I would come no nearer the Shore than six Fathoms ; and no nearer the Goodwind-sands than ten or eleven Fathoms ; in some Places the nearer I go to the Sands I should have the deepest Water ; but then there would soon be so little Water, that I should be a ground before I could perceive its Shoal, I would therefore stand towards the South Foreland in nine Fathoms, and to the South Sand-head in seven Fathoms, there being gradual Soundings.

Q. What are the Marks for running through the Gull Stream ?

A. To keep the Light-house on the South Foreland in one with the westernmost End of the southernmost Clift in Old Stains Bay.

N. B. Stains Bay is a Swamp that lies between two Clifts, which lies a large Half-mile to the Southward of Kingsdown upon the South Foreland.

Q. What are the Marks of the Dangers going out of the Downs ?

A. Upper Deal Mill in one with the Corner of Warner Castle will lead me clear off. Upon Deal Church being open with the said Castle about a Ship's Length, I must stand out so till I bring the Light-house in one with the Castle, and then I shall be a-breast of the South Sand head ; and, when the Light-house opens to the Westward of Folkstone Church with Hay Clifts, it leads me clear. I must observe not to shut in the Hopeland E. by N. and the South Sand-head will lie off a full League.

Q. Suppose you were coming into the Downs, with the Wind at West blowing hard, which Way would you lay your Ship's Head ?

A. I would come-to with my best Bower, and lay my Ship's Head to the Eastward ; but if with the small Bower, I would lay her Head to the Westward.

Q. For what Reason would you do so ?

A. Because I should thereby keep my Cable clear of the Cut-water.

Q. What is the Course from the South Foreland to Dungeness, and what are the Dangers ?

A. From the South Foreland to Dungeness the Course is S. W. by W. Distance five or six Leagues ; the Dangers between them are the Ripraps ; the shoalest Part of which lies from Dover S. four Leagues ; from Calais Clifts W. by S. from Folkstone S. E. and and E. S. E. four Leagues : from Dungeness it lieth in Length N. E. and S. W. Distance about four Leagues, both Ends pointing to

to the English shore; it is very narrow, and has on it but fifteen Feet at Low-water: I would come no nearer than twenty Fathoms. When the Nefs bears N. W. by N. I am to the Northward of it: It flows at the Ripraps N. E. and S. W. and the Tide runs to the Eastward till three o'Clock Full and Change, when it is half-ebb by the Ground.

Q. How would you come to an Anchor under Dungeness?

A. I would bring the Nefs Point to bear S. W. by S. or S. W. in nine Fathoms: in passing it I would come no nearer than twelve or fourteen Fathoms: I would anchor to the W. with the Point E. or E. by S. in nine or ten Fathoms.

N. B. It flows at the Nefs S. E. by S. and N. W. by N. the Tide runs to the Eastward till Two o'Clock Full and Change.

Q. What is the Course from Dungeness to Beachy Head, and what Dangers are there?

A. From the Nefs to Beachy the Course is W. S. W. Distance eight or nine Leagues; there is a Shoal between them called Pevensey Sand; and has on it at Low-water and Spring, not twelve Feet; it lays about E. by S. from Beachy, and S. $\frac{1}{2}$ W. from Pevensey Castle, Distance from the Shore about two or three Miles.

N. B. It flows off Beachy and in the Offing N. by W. eleven Hours, and S. by E. eleven Hours.

Q. Suppose you were off Beachy Head, bound down the Channel, and the Wind came to the South; what would you do?

A. As the Variation is in my Favour, I would trim all sharp, and stand to the Westward, and I judge, if it did not overblow, I should clear all.

Q. Being off Beachy Head with a Gale of Wind at N. E. bound to Spithead, and at the Close of the Evening, what is best to be done?

A. I would lie-to with my Ship's Head to the N. N. W. till Morning, then she would drive about a Channel Course. at the Rate of two Miles an Hour, allowing what she would lose on the Ebb, she would gain on the Flood, and be in the fair Way in the Morning; I must come no nearer the Owers, than eighteen or nineteen Fathoms.

Q. In sailing from Beachy to the Isle of Wight, what Course would you steer, and what Dangers are there?

A. The Course is W. by S. Distance 16 or 17 Leagues. The Dangers between them are the East Borough-Head, which lies from Arundel S. S. W. 7 Miles, and the Owers which lie from Chichester Church S. S. E. 4 Leagues. The leading Marks to carry you clear of the Owers, are Dunnose Point W. or W. by N. and Culver Cliffs N. W. by W. or W. N. W. When Chichester Church bears N. by E. I am to the Northward of the Owers.

Q. What is necessary to be observed in sailing into Spithead?

A. If

A. If I were bound into Spithead, after I am to the Westward of the Owers, I would steer N. W. by W. or W. N. W. and open Sandown Castle with the Culver Cliffs, till I could see St. Helen's Church a Sail's Breadth or two open with the Bed Cliffs of Bembridge Point, and that will clear the Ledge; then by steering N. W. for the Buoys, I should see the Gilkickers, must keep them in one, and that will lead me between the Buoys of the Warners and of the Dean, and then on Portsdown I shall see a large Chalk-pit, that and South-sea Castle in one, will lead me clear up to Spithead, between the Buoy of the Horse and No Man's Land.

Q. In turning into Spithead, what do you observe, and how do you come to an Anchor there?

A. I may open the * Kickers each Way, but in Case a Fleet be at Spithead that should obstruct the Sight of them each Way from me, there is a Mark on the Top of the Down on the Wight; by keeping that open above the Trees, it will carry me clear up to Spithead; and when the said Mark bears S. W. or S. W. by S. I am a-breast of the Horse: I must come no nearer to it than seven Fathoms; nor to No Man's Land than twelve or thirteen Fathoms. I would anchor at Spithead with the Kickers N. W. the Ride W. S. W. and South-sea Castle E. by N. or E. N. E. in eight, nine, or ten Fathoms.

Q. How would you come to an Anchor at St. Helen's?

A. I would keep Sandown Castle just open with the Culver Cliffs, till I should bring St. Helen's Church a Sail's Breadth open of the Red Cliffs of Bembridge Point, or Ledge, (there are six or seven Fathoms Water) and anchor with the Church on the S. W. by W. or W. S. W. in eight or nine Fathoms.

Q. Suppose you were moored at Spithead, with a Cable and a Half on the best Bower, and one on the small Bower, and you have Orders to sail; at what Time of Tide would you unmoor? and which Anchor would you take up first?

A. I would begin to unmoor at the first of the Flood, and take up my small Bower first.

Q. In sailing round the Wight what are your Observations?

A. To keep clear of Ride Middle, I would keep South sea Castle a Sail's Breadth open of the Kickers, till I open West Cowes Castle, till I am two-thirds over; then steer directly for Hurst Castle, and when a-breast of it, borrow pretty near it, and then steer right for the Needles Point: great Regard must be had to the Tides, for the Flood sets on the Needles, and the Ebb on the Shingles.

N. B. It flows at St. Helen's nine Hours at the Full and Change, and when it is half Water you have a Tide to work it with; there is a Shoal, called the West Middle, about two Miles
W. by

* As the Kickers are now down, take the S. W. Part of the Fort, or Battery instead of them.

W. by N. half N. from Ride Middle; it lies S. E. and N. W. about a Mile and a half in Length, and has but twelve Feet at Low-water; when you are a-breast of the N. W. Part of it, Calshot Castle is N. N. W. half W. South-sea Castle will then carry you clear of it, if you keep it a Sail's Breadth to the Southward of the Gilkicker Point.* The Brambles is a Shoal that lies N. N. W. from the West Middle, Part of it is dry at low Water. If you sail to the N. W. of the West Middle, you sail between it and the Brambles, leaving the Brambles on the Starboard Side. When you come to the West of Cowes-Castle, you must give it a good Birth, by Reason of a Ledge of Rocks that lie off from it. There is Warding's Rock that lies on the Island Side; to keep clear of which, you must keep the Vanes of the Windmill that is on the Isle of Wight in Sight; and that will carry you clear. When you come near the Needles, give them a good Birth to avoid the Chalk Rock: You will have in the fair Way nine or ten Fathoms; but when you come to the Chalk Rock you will have but four Fathoms.

Q. If you are bound or forced into Portland, what Precautions are necessary?

A. I must take Care of the Shambles; they lie about E. by S. or E. S. E. three Miles from the Bill of Portland, and have but 14 or 15 Feet on them at low Water. To go into the Road, I must keep Weymouth Castle open with the Eastermost Part of Portland, or open with the Stone Pier, and run until I bring the Eastermost Part of Portland S. by E. or S. S. E. in 8 or 9 Fathoms; keep Week Church open, and that will carry you clear. It flows from the Road to the Bill E. S. E. $7\frac{1}{2}$ Hours. The Light-houses bear from each other N. and S. the Flood sets right off the Bill 9 Hours.

Q. How would you anchor in Torbay?

A. Bring the Bury-head to S. by E. or S. S. E. and let go my Anchor in 8 or 9 Fathoms Water.

Q. What is to be observed in sailing into Plymouth Sound?

A. If coming from the Westward, and am got round the Ram-head, I must give Penlee Point a good Birth, by Reason of a Ledge of Rocks that lies off from it; then haul N. N. E. $\frac{1}{2}$ E. For anchoring, the best Mark is Mount Edgecumbe just open, the Withy Hedge right up and down, and St. Nicholas's Island N. W. the leading Mark is Plymouth Church open with the West Part of the Citadel. The Dangers in going in are the Tinker, N. by W. one Mile and a half; and about half a Mile East Southerly from it, is the Shag Stone; there is a Buoy on each of them. The

F f

Shovel

* The Lower Gilkicker is now down, and a Battery built in its stead.

Shovel, with a Buoy on it, lies East of Staddon Point. About half a Mile East of this lie the Panther Rock and the Knap. I would leave them on the Starboard Side. the Knap, Shag Stone, and New Stone, bears from the Bolt, N. W. by W.

N. B. Or to sail into the Sound you may bring the Old Church in a Line with the White Patch on the Hoar; sail in that Direction till Edgecumbe House appears in Sight, then steer over to the East Side, and anchor with Blockhouse Point in a Line with Drake's Island.

Q. What are the Dangers failing into Falmouth Harbour, and the best Way to avoid them?

A. The Dangers are the Manacles and the Falmouth Rock. The Manacles lie S. and S. by W. from Falmouth Harbour; and the Rock is known by a Pole standing on it, and lies nearest the West Shore. The best going in is on the East Side of the Rock; it is a narrow, deep Channel, which I may sail up the Lead, and borrow to St. Mawe's Side to 5 or 6 Fathoms Water; the East Side is the shortest. The best anchoring is in Carrick Road, St. Mawe's Castle bearing E. S. E. laying my Eastermost Anchor in 18 Fathoms, and my Westermost in 6 or 7 Fathoms.

Q. What are the Dangers that lie off the Lizard and the Land's End?

A. Many. 1st. The Ruddlestone is a Rock that lies almost to the South Eastward of the Land's End, Distance about 4 Miles; to avoid it, I must keep the Tower of the Church that stands on the Land's End open, and that will carry me clear of it; but if I keep so near the Land as to hide the Church, then I go between the Land and the Rock; and when I am a-breast of the Red Cliffs that are by the Water Side, then I am a-breast of the Rock. 2dly. The Vaule is a Rock that lies about S. S. W. of the Land's End, Distance 3 Leagues, and makes like the Bottom of a Ship at half Tide. There are 43 Fathoms Water close to it on either Side. 3dly. The Gulph or Wolf Rock lies from the Lizard about West, Distance 10 Leagues, and from the Land's End S. W. Distance 4 Leagues; it is peaked, and appears above Water at half Tide; round about it is a clear Ground. 4thly. Breson lies from the Land's End about N. or N. by W. Distance 5 Leagues. 5thly. The Seven Stones are a Row of Rocks that come not above Water, but the Sea always breaks over them: They lie from the Land's End W. $\frac{1}{2}$ S. Distance 7 Leagues, and from St. Martin's Head, Scilly, N. E. Distance 3 Leagues.

Q. How does the Land's End appear when you first make it?

A. It appears Hummocks, with a Church on it; and may be seen in 54 Fathoms Water, 8 or 9 Leagues off.

Q. How do you know the Lizard when you first make it?

A. It

A. It is the Southermost Land on the Coast, and may be seen 7 or 8 Leagues off, in 42 Fathoms Water.

Q. If you were forced into Mount's Bay, where would be the safest anchoring Ground?

A. Mount's Bay lies between the Lizard and the Land's End; on the East Side of it is a high Island, and on the West a Castle, called St. Michael's Mount. From the Eastward of the Bay lies a Ledge of Rocks near a League into the Sea; the Coast is full of Rocks, and not safe to anchor in. To sail into this Place I must bring St. Paul's Steeple W. N. W. keep over to the West Shore, and make St. Clement's Island, which is before the Town of Mouseholes, having the Castle on the Starboard Side: I shall then see a large Sandy Bay; and, when within the Island, there is good anchoring in 7 or 8 Fathoms Water, Land-locked from all Winds but a S. E. Wind.

Q. What are the Dangers going into Scilly, and the best Marks to avoid them?

A. St. Mary's Sound is the best Way into Scilly. St. Mary's Island lies on the S. E. Side, and hath a Garrison thereon, and a Windmill a-breast of it. The Dangers are 1st, The Spanish Lodge which I must leave on the Larboard Side near Smith's Island; it shews itself in bad Weather; and the next is Norman's Rock, on the Starboard Side, above a Cable's Length from the first. From St. Mary's Island, a little without the Eastermost Point, the Mark to lead me is to keep the Vanes of the Windmill upon a Line with the two Rocks that lie on the West Side, so that I may go between them into the Fair Way.

Direction for Working a Ship in all difficult Cases that probably may happen at Sea.

Q. Suppose your Ship is lying at Spithead, and the Wind at N. E. at what Time of the Tide would you unmoor?

A. As soon as she tends to the Ebb, I would wear away upon my small Bower, and take up my best Bower.

Q. How do you unmoor?

A. I would turn all Hands up, see all clear below, rig the Davit, overhaul the Cat and Fish, ship the Bars and Pins; then send some Hands down to the Cable, clap the Stoppers on the best Bower before I unbit it; then rouse down the Slack, bring to the Vial, and heave taut; then clap the Stoppers on the small Bower before the Bits, and unbit. If there is a fresh Breeze, I'll wear with it bitted; then heave on the best Bower till it is above the Surface of the Water, then pall; out Bars, hook the Cat, haul it taut, and surge the Vial, then stick out the Cable below, belay the Cat, pass the Stoppers, and haul the Fish by Hand; then hook and bouse to the Stock,

belay the Fish, haul in the Buoy and Rope, and pass my Shank Painters, then slack the Cat and Fish, unhook the Anchor, and see all clear for letting it go again. I would likewise bit the best Bower with a Range, rig the Davit out on the other Side for the small Bower, shift the Vial, and proceed as before. If it does not blow hard, I would loose the Top sails, and when the Anchor's a-peak, or when I think myself near enough without tripping it, I would haul home my Top-sail sheets and hoist them.

Q. How do you cast a Ship?

A. If I am to cast the Ship to Starboard, would haul my Larboard Braces forward, and let my After-yards lie square: I may hoist the Fore-top-mast-stay-sail, and keep the Sheet to Windward to help her. If I am to cast her to Port, I would haul in the contrary Braces; when cast, fill the Head-sails, and brace up as Circumstances require.

N. B. If the Ship is Wind-ride, as soon as the Anchor is right up and down, put the Helm the Way you would have her cast, setting in the same Braces abaft, and the contrary forward; but if she is Tide-ride, put your Helm the contrary Way to which you would have her cast, and set in your Braces forward. Which ever Way your Helm is, your Braces abaft must be the contrary.

Q. How would you tack a Ship with all her Sails set?

A. I would hand down the Lee-bow-lines, stretch along the Weather-braces, haul taut the Weather-sheet and Lee-tacks; then put the Helm to Lee; let go the Fore-sheet and Fore-top-bow-line, Jibb, and Stay-sail-sheets: When the Fore-top-sail touches, brace to and help her. When aback, brace and help her. When the Wind is out of the After-sails, raise the Tacks and Sheets, shift the Stay-sail-tacks, and haul over the Stay-sail-sheets. When the Wind is a-head, haul the Main-sail. If she has Sternway, shift the Helm, square the Sprit-sail-yard, haul on board the Main-tack, and aft the Main-sheet; brace up the Main-yard; when the After-sails are full, let go and haul: Haul on board the Fore-tack, keep in the Weather-braces forward, and let her come to; then brace up, haul aft the Fore-sheet, Jibb, and Steering-sails, set the Back-stays up, and haul the Bow-lines; then haul taut the Weather-braces, Lee-tacks, and Weather-sheet.—Note, should the Wind take me a-head, I may haul the After-sails about, shift the Mizzen-sheet, and Stay-sail tacks, and then work the Ship the same Way as in Tacking.

Q. How would you tack a Ship under her three Top-sails?

A. I would put the Helm to Lee, keep fast the Fore-top-bow-line; when the Fore-top-sail touches, brace to and help her; when the Wind is a-head, haul the Main top-sail, and shift the Helm; then brace up the Main-yard, and haul the Main-top bow-line,
When

When the After-sails are full, let go and haul; keep in the Weather-braces forward, and when she comes to, brace up and haul the Main-top-bow-line and Weather-braces.

Q. How would you wear a Ship with all her Sails set?

A. I would haul the Mizzen up, and the Mizzen-stay-sails down, hard a Weather the Helm, shiver the Mizzen top-sail, let go the Main and Main-top-bow-lines, ease off the Main-sheet, the Lee-main-brace, and round in the Weather-braces. When the Wind is abaft the Beam, ease the Main tack; when the Wind is aft, square the Head-sails, and get the Tacks on board; get aft the Sheets, shift the Jibb and Stay-sail-sheets over the Stays, and as she comes to, haul the Mizzen out, and haul aft the Mizzen-stay-sail-sheet, brace the Head-yards up, haul the Bow-lines, and trim all sharp. If a fresh Wind, it is proper to shorten Sail; in Top-gallant-sails, down Jibb, and Steering-sails, take two Reefs in the Top-sails. If it continues to blow harder, in Top-sails; I would take in the Fore and Mizzen-top-sails first, because it will ease the Ship forward; for when it blows hard we generally have a Head-sea, and she keeps to the better. Let go the Fore-top-bow-line, lower away the Haul-yards, man your Weather Clew-line and Bunt-lines, clue close up your Weather-sheet. In Weather-brace up your Lee-sheet. Steady your Lee-brace. Steady taut your Top sail haul-yards; send the People up to hand the Sail, and when they are up, before they go on the Yard, clap on your Rolling-Tackle to steady the Yard, (and all the Top sails should be taken in the same Way): Then take in the Main-top-sail, and the Ship is under her Courses.

Q. How would you wear a Ship under her Courses?

A. Haul the Main-sail up, and down Mizzen-stay-sail, square the After-yards, and hard a-weather the Helm; man the Weather fore-braces, and let go the Lee-brace, and fore Bow-line; let go the Fore-tack, and get on board the other, keep her large if Room, until you get the Tack on board and belay it. Then luff up the Wind, aft your Fore-sheet and brace it up. Set the After-sails, aboard Main-Tack, aft Main-sheet, brace all up, and haul the Bow-lines; and when your Sails are trimmed, shift your Rolling-tackles on the Top sail-yards.

Q. How would you wear a ship under a Main-sail, the Fore-stay-sail being blown away?

A. To lay to upon the other Tack I must watch the Ship's falling off, put the Helm a-weather, and as she falls off ease off the Sheet; but if that will not do, I would get some Hands up in the Fore-shrouds with Tarpaulins; if she will not wear with this Method, I would haul aft the Main-sheet again, and lay her to as before, and then get a Piece of Canvas, and lash it round the Lee-quarter of the Sprit-sail-yard, and top the Yard up as much as possible to prevent

vent the Sail from filling with Water when it is loosed. When the Ship falls off, put the Helm a-weather, cast loose the Lee-yard-arm of the Fore-sail, and haul aft the Sheet, and as the Ship falls off, ease off the Main-sheet, and gather aft the Weather-brace; raise the Tack, and gather aft the Sheet, and when the Ship is before the Wind, get on board the other Tack, aft the Sheet, square the Sprit-sail-yard, furl the Sail, ease down the Helm, haul close aft the Main-sheet, brace up sharp, and haul the Bow-line.

Q. Suppose she will not wear for all this?

A. Then I would loose the Goose-wings of the Forefail; if that will not do, set the Forefail, and wear her as under Courses, or haul the Main-sail up; if by hauling the Main-sail up and handing it she will not wear, strike the Mizzen-yard lower down, strike the Cross-jack-yard and Mizzen-top-mast; and if that will not do, cut away the Mizzen-mast.

Q. How would you proceed if a Top-sail splits?

A. Let go the Bow-lines, and lower away the Haul-yards, clue up the Lee-sheet, and haul up the Bunt-lines, start the Weather-sheet, haul in the Weather-brace, belay the Clue-line, Bunt-line, and Brace, unbend the Sail, and bend another, then either furl, or set it as Circumstances require.

Q. Suppose it blows hard and you split your Main-sail, what would you do?

A. I would haul it up, and settle the Yard; unbend the Sail, and bend another; get aboard the Main-tack, and aft the Sheet, and then sway the Yard-up. The Sail being a-back will prevent its fluttering. Let the Sail fill, which will help and make the Yard go up the easier; while I am doing this the Mizzen-stay-sail should be set. When the Sail is full, and the Wind blows hard, get a Tackle on the Weather-leach to secure the Tack, and Preventer-sheets; but in small Ships they get the Lee-tacks for Preventer-sheets.

Q. How would you box a Ship off?

A. Put the Helm to Weather, haul up the Mizzen, and down the Mizzen-stay-sail, raise the Fore-tack, let go the Fore and Fore-top bow-lines and Fore-sheet, round in the Weather-braces forward, haul the Jibb and Stay-sail Sheets in flat forward, and up the Lee-bow-lines: If she has Stern-way, put the Helm to Lee: When she pays off, and the After-sails are all full, ease off the Jibb and Stay sail Sheets: brace about the Head-sails, and bring on board the Fore-tack; but if she has Head-way, right the Helm, and tend her coming to; then brace up sharp, haul the Bow-lines.

Q. Suppose you are on a Wind, close up the Land, and standing on must run on Shore, and you can clear the Land on the other Tack; but it blows hard, and a Head-swell that she wont stay, and should

should you wear you would be on Shore, how will you get upon the other Tack?

A. Some would say I should Club haul her. This is done by putting the Helm to Lee, and letting go the Lee Anchor, and bring her up, Head to Wind, cut the Cable, and haul about the After-sails; and when they are full, brace about the Head-sails, haul on board the Fore-tack, and brace up the other Way; but that which is most common is, by Box-hauling her.

2. How would you Box-haul a Ship?

A. If she refused Stays, I would haul the Mizzen up, haul about the After-sails, and let go the Weather-bow-lines forward; haul the Lee-bow-lines, set in the Weather-braces, and keep the Head-sails a back to prevent the Ship's having Head-way, by which Means she will pay round in her Length. I must observe to keep the Helm a-lee, by Reason she will have Stern-way, and as she falls off, must keep the After-sails shivering; when she is before the Wind, brace up abaft, and get aboard the Fore-tack, and as she comes to, haul the Mizzen out, and trim sharp.

2. Suppose you are upon a Wind, and let the Ship come up in the Wind, and are all aback, what would you do?

A. Haul the Mizzen up, let go the Main and Main-top-bow-lines, the Lee-main and Main-top-sail-braces, and lay all square abaft; put the Helm to Leeward if she has Sternway; when the Wind is abaft, shift the Helm; and as she gets Head-way, haul in a little of the Starboard Braces abaft, haul the Mizzen out, and brace sharp up abaft, and haul the Bow-lines, and then I am on the same Tack as before.

2. If by Accident your Ship was brought by the Lee, what would you do?

A. When a Ship is brought by the Lee, it is commonly occasioned by a large Sea, and by the Neglect of the Helm's-man. When the Wind is two or three Points on the Quarter, the Ship taking a Lurch, brings the Wind on the other Side, and lays the Sails all dead to the Mast; as the Yards are braced up, she then having no Way, and the Helm being of no Service, I would therefore brace about the Head-sails sharp the other Way, then haul the Main-sail up, and just keep the Main and Main-top-sail shivering: When she gathers Way, and brings the Wind aft again, raise the Fore-tack, and square the Head-sails; trim the Sails as they were before, and bring her to her Course again handsomely.—N. B. It is dangerous to bring a Ship by the Lee in a Gale of Wind; for she lying entirely against the Sea, her Sails can be of no Service till braced about.

2. Suppose you were upon a Lee-shore, and had neither Room

to wear or stay, nor any anchoring Ground, how would you put the Ship's Head round the other Way?

A. I would put my Helm hard to Lee, and when she comes Head to Wind, raise the Main and Fore-tacks directly, make a Run with my Weather-braces, and clap all back at once; then haul forward the Lee-tacks and Bow-lines as far as I can, that the Ship may fall round on her Heel; and when the Main-sail begins to shiver, I would haul it up, and fill my Head-sails, and shift the Helm hard a-weather; then when the Wind comes on the other Quarter, haul on board the Main-tack, and bring her close to the Wind.

Q. Suppose you were upon a Lee-shore, and had neither Room to wear or stay, and you had anchoring Ground, what would you do?

A. When I see the Danger, I would take a good Hawser and lead it out of one of the Quarter-ports, and bend it to the Anchor to Leeward; the other Part I would bring to the Capstan, and ship the Bars, and when I go to tack, clap my Helm a-lee: As soon as the Wind is out of the Main-sail haul it up, and then let go the Anchor, and heave on the Spring to cast her; because the Cable should not check her when she comes Head to Wind: Brace about the Main-yard, haul on board the Tack, and cut away the Cable and Spring; when the Main-sail fills, set the Fore-sail; haul aboard the Tack, and trim her to the Wind.

Q. Suppose it blows hard, and you cannot carry your Courses, Night coming on, and it is likely to blow harder, what will you do?

A. I would haul the Fore-sail up and furl it, balance the Mizzen and reef the Main-sail, haul the Mizzen out to keep her to, then haul up the Main-clue-garnet and Bunt-line, square the Yard, and get Stops round the Mast by the Booms to hook the Yard-tackles to for Rolling-tackles; then lower down the Yard, and reef the Sail; haul on board the Tack, gaff ast the Sheet handsomely, and sway the Yard up. Tend the Braces, bouce up the Bow-line, and haul up the Mizzen.

Q. You are just a-breast of Portland, the Wind has taken you a-back, and you have not Time to take in your Sails, for you will be on Shore presently; how will you proceed?

A. If she has Head-way, I will put the Helm a-weather, let go the Fore-sheet and Larboard-braces; as soon as the After-sails shiver, haul down the Main-topmast Steering-sails, and if it blows fresh take in Topgallant-sails. Brace up the After-yards; when full, brace up forward, and haul on board the Fore-tack, and trim all sharp; haul taut the Weather-braces, and haul the Bow-lines.

Q. Sup-

Q. Suppose the Ship is under Top-sails, and you must make all the Sail you can ?

A. Down Fore-sail, hoist Jibb and Stay-sails, set Top-gallant-sails and Royals fore and aft, set Sprit-sail, and Sprit-sail-top sail and Driver ; haul taut the Lee Clew-lines and Weather-lifts and Braces ; then rig out the Top-mast-steering-booms, and send down the Haul-yards and Tacks ; then hoist up the Top-mast-steering-sails and Top-gallant-steering-sails, and then set the lower Steering-sail forward.

Q. In case you were to carry away your Mast, what Method will you take to get clear of the Wreck ?

A. I would put my Helm a-weather to give the Ship some Way through the Water, and then cut away.

Q. Suppose you were to carry away your Bowsprit, what would you do ?

A. Should that happen, or that I should spring my Bowsprit, I would immediately wear Ship, and keep her before the Wind ; and then, for Security of the Foremast, I would carry forward Runners and Tackles, and bounce them well taut, till I can get a Hawser, or sufficient Rope, and clench it round the Mast-head, and secure it to the Bits of the Fore-castle, or to the Cat-heads.

Q. Suppose the Wind at S. W. and you are well up the Channel, making the best of your Way to the Downs, how will you proceed if it blows hard, and you are under a Main-sail ?

A. Reef the Fore-sail, and then haul the Main-sail up, and wear Ship, then furl it ; when before the Wind, set the Fore-sail ; when a-breast the Foreland, haul the Fore-sail up and furl it, and run in under bare Poles. Hook the Top-Tackle-falls ; see the Lee-jeers ; Top-sail-shifts, Lifts, and all clear for striking Yards and Top-masts. Then run into a good Birth, and strike Yards and Top-masts : The Sheet-anchor being over the Side, and the best Bower bitted with a long Range, the Stoppers, Ring-ropes, and Stream buoy all ready, put the Helm to Port, haul the Mizzen out, and let go the best Bower, and veer away two Cables before I check her ; then veer away Half a Cable more, and bring her up. When the Ebb makes, I would let go the small Bower in nine Fathoms Water, having Deal-Mill and Deal-Castle in one.

Necessary Remarks on Coming into the Channel.

PERSONS coming from a long Voyage, without Doubt, try for Ground in Time, and, if possible, would keep in the Latitude of 49° N. in which Latitude, and in ninety Fathoms Water, you will have five Sand-sixty-six Leagues from the Lizard ; but, should you be in the Latitude of Scilly, then coarse Ground, and eighty Fathoms.

In coming in, having struck Ground in ninety Fathoms, you will, from the Latitude $49^{\circ} 30'$ to 49° , meet with the same Depth : then, failing six or seven Leagues, you will shoal five Fathoms at once ; you run in that Depth for some Time, and deepen again ; and perhaps in three Leagues you shoal again ; for it is to be supposed the Ground is not gradual : You must therefore have Recourse to the general Soundings, not to Particulars. But if, in coming in, you meet with Sand interspersed with black Specks like beaten Pepper, and you have sixty-four Fathoms, then Scilly bears N. E. by N. fourteen Leagues ; and if, at any other Depth, you have the same Soundings from ninety to sixty-four Fathoms, you have the Channel fairly open. When you are in the Latitude of $49^{\circ} 30'$, and have seventy-five Fathoms, you must be sure to steer E. by S. or E. S. E. and then you will but keep your Latitude good ; which, if possible, do not go to the Northward of, till you get within Scilly ; nor then, without you have an Opportunity of making the Land. When you are a-breast of Scilly, if you be not to the Southward of $49^{\circ} 25'$, nor to the Northward of $49^{\circ} 20'$, and have sixty Fathoms, you are sure to be the Length of Scilly, and in the Latitude as before-mentioned ; with thirty-five Fathoms you are a-breast of the Lizard.

If at any Time you should be to the Southward, and have from ninety to seventy Fathoms, or in the Latitude of Ushant, or farther Southerly, you will have reddish Gravel Sand, with many Pieces of Shells ; which Soundings are no where to be found in the Channel. If in the Latitude of Ushant you have eighty-six Fathoms, you are distant from thence thirty-six Leagues : if seventy Fathoms, eleven Leagues ; then you must be careful in the Night or thick Weather to come no nearer to it than sixty-three Fathoms, nor to the Leams than sixty five Fathoms. You may know when you are to the Northward or to the Southward of Scilly by the Ground. When you are to the Northward, or in the Latitude of it you have Ouze on the Lead from eighty five to sixty Fathoms ; then you must haul to the Southward till you meet with coarser Ground, which you will have to the Southward of Scilly ; you may depend on having Ouze on the Lead in this Latitude, or to the Northward of it ; so that if you keep the Lead going, you may prevent falling to the Northward. For your better knowing when you are near Scilly, you will find on the Lead black Stones, the like of which are no where else in the Channel. In the Night come no nearer than fifty-three Fathoms ; and in that Depth you are not above three Leagues from the Scilly Rocks. That you may know if you be within Scilly, and in the Channel, stand to the Southward, and you will have deeper Water ; to the Northward, and you will have shoaler. Come no nearer to the Lizard, in the Night, than forty-five Fathoms. If running up the Channel in the Night, keep without the Stream of forty Fathoms, for in that Stream the Eddystone lies : between the Start and Portland, no nearer than twenty-four Fathoms ; nor from Portland to the Ness, than twenty Fathoms ; if in the Night or thick

Weather,

Weather. When you are in the Fair-way, up Channel, you will always have fine Sand, intermixed with black Speck's and Hake's Teeth. By this Time you will most probably have made the Land; but observe that between Beachy and the Wight there are from thirty to thirty-eight Fathoms Water; by which you may be led to imagine yourself farther out than you are. That Depth is found at four Leagues Distance from the Owers and Eastborough head.

Having proceeded so far in the Examination of the young Officer, it may not perhaps be thought superfluous at this Time to give him some Idea of the Manner of an Engagement at Sea, we shall therefore begin with the Exercise of the great Guns.

Exercise of the Great Guns.

- | | |
|--------------------------|-------------------------|
| 1 Silence | 8 Fire |
| 2 Cast loose your Guns | 9 Sponge your Guns |
| 3 Level your Guns | 10 Load with Cartridge |
| 4 Take out your Tompions | 11 Shot your Guns |
| 5 Run out your Guns | 12 Put in your Tompions |
| 6 Prime | 13 House your Guns |
| 7 Point your Guns | 14 Secure your Guns. |

UPON Beat to Arms (every Body having immediately repaired to their Quarters) the Midshipman, commanding a Number of Guns, is to see that they are not without every necessary Article, as (at every Gun) a Sponge, Powder-horn, with its Priming-wires, and a sufficient Quantity of Powder, Crow, Handspike, Bed, Quoin, Train-tackle, &c. sending, without Delay, for a Supply of any Thing that may be missing; and for the greater Certainty of not overlooking any Deficiency, he is to give strict Orders to each Captain under him, to make the like Examination at his respective Gun, and to take Care that every Requisite is in a serviceable Condition, which he is to report accordingly. And, besides the other Advantages of this Regulation, for the still more certain and speedy Account being taken upon these Occasions, the Midshipman is to give each Man his Charge at Quarters (as expressed in the Form of the monthly Report) who is to search for his particular Implements, and, not finding them, is immediately to acquaint his Captain, that upon his Report to the Midshipman, they may be replaced. The Man who takes care of the Powder is to place himself on the opposite Side of the Deck from that where we engage, except when fighting both Sides at once, when he is to be amidship. He is not to suffer any other Man to take a Cartridge from him, but he who is appointed to serve the Gun with that Article, either in Time of a

real Engagement, or at Exercise. Lanthorns are not to be brought to Quarters in the Night, until the Midshipman gives his Orders for so doing to the Person he charges with that Article. Every Thing being in its Place, and not the least Lumber in the Way of the Guns, the Exercise begins with,

1. Silence.

At this Word every one is to observe a silent Attention to the Officers.

2. Cast loose your Guns.

The Muzzle-lashing is to be taken off from the Guns, and, being coiled up in a small Compass, is to be made fast to the Eye-bolt above the Port, the Lashing-tackles at the same Time to be cast loose, and the Middle of the Breeching seized to the Thimble of the Pomillion. The Sponge to be taken down, and with the Crow, Handspike, &c. laid upon the Deck by the Gun.

N. B. When prepared for engaging an Enemy, the Seizing within the Clinch of the Breeching is to be cut, that the Gun may come sufficiently within board for loading, and that the Force of the Recoil may be more spent before it acts upon the Breeching.

3. Level your Guns.

The Breech of your Metal is to be raised, so as to admit the Foot of the Bed's being placed upon the Axeltree of the Carriage, with the Quoin upon the Bed, both their Ends being even one with the other.

N. B. When levelled for firing, the Bed is to be lashed to the Bolt which supports the inner End of it, that it may not be thrown out of its Place by the Violence of the Gun's Motion, when hot with frequent Discharges.

4. Take out your Tompions.

The Tompion is to be taken out of the Gun's Mouth, and left hanging by its Laniard.

5. Run out your Guns.

With the Tackles hooked to the Upper Bolts of the Carriage, the Gun is to be bowled out as close as possible, without the Assistance of Crows or Handspikes; taking Care at the same Time to keep the Breeching clear of the Trucks, by hauling it through the Rings; it is then to be bent so as to run clear when the Gun is fired. When the

the Gun is out, the Tackle-falls are to be laid along-side the Carriages in neat Fakes, then when the Gun, by recoiling, overhauls them they may not be subject to get foul, as they would if in a common Coil.

6. Prime.

If the Cartridge is to be pierced with the Priming-wire, and the Vent filled with Powder, the Pan also is to be filled; and the flat Space, having a Score through it at the End of the Pan, is to be covered, and this Part of the Priming is to be bruised with the round Part of the Horn. The Apron is to be laid over, and the Horn put up out of Danger from the Flash of the Priming.

7. Point your Guns.

At this Command the Gun is, in the first Place, to be elevated to the Height of the Object, by means of the Side-sights; and then the Person pointing is to direct his Fire by the upper Sight, having a Crow on one Side and a Handspike on the other, to heave the Gun by his Direction till he catches the Object.

N. B. The Men who heave the Gun for pointing are to stand between the Ship's Side and their Crows or Handspikes, to escape the Injury they might otherwise receive from their being struck against them or splintered by a Shot; and the Man who attends the Captain with a Match is to bring it at the Word, "Point your Guns," and kneeling upon one Knee opposite the Train Truck of the Carriage, and at such a Distance as to be able to touch the Priming, is to turn his Head from the Gun, and keep blowing gently upon the lighted Match to keep it clear from Ashes. And as the Missing of an Enemy in Action, by Neglect or Want of Coolness, is most inexcusable, it is particularly recommended to have the People thoroughly instructed in pointing well, and taught to know the Inconveniences of not taking proper Means to hit their Mark; wherefore they should be made to elevate their Guns to the utmost Nicety, and then to point with the same Exactness, having caught the Object through the upper Sight at the Word.

8. Fire.

The Match is instantly to be put to the bruised Part of the Priming; and when the Gun is discharged the Vent is to be closed, in order to smother any Spark of Fire that may remain in the Chamber of the Gun; and the Man who sponges is immediately to place himself by the Muzzle of the Gun in Readiness, when at the next Word,

9. Sponge

9. Spunge your Guns.

The Spunge is to be rammed down to the Bottom of the Chamber and then twisted round, to extinguish effectually any Remains of Fire; and when drawn out to be struck against the Outside of the Muzzle, to shake off any Sparks or Scraps of the Cartridge that may have come out with it, and next its End is to be shifted ready for loading; and, while this is doing the Man appointed to provide a Cartridge is to go to the Box, and by the Time the Spunge is out of the Gun, he is to have it ready; and at the Word,

10 Load with Cartridge.

The Cartridge (with the Bottom End first, Seam downwards, and a Wad after it) is to be put into the Gun, and thrust a little Way within the Mouth, when the Rammer is to be entered; the Cartridge is then to be forcibly rammed down, and the Captain at the same Time is to keep his Priming-wire in the Vent, and, feeling the Cartridge, is to give the Word *home*, when the Rammer is to be drawn, and not before. While this is doing, the Man appointed to provide a Shot is to provide one, or two, according to the Order at that Time, ready at the Muzzle, with a Wad likewise, and when the Rammer is drawn, at the Word,

11. Shot your Guns.

The Shot and the Wad upon it are to be put into the Gun, and thrust a little Way down, when the Rammer is to be entered as before. The Shot and Wad are to be rammed down to the Cartridge, and there have a Couple of forcible Strokes, when the Rammer is to be drawn, and laid out of the Way of the Guns and Tackles, if the Exercise or Action is continuing; but, if it is over, the Spunge is to be secured in the Place it is at all Times kept in.

12. Put in your Tompions.

The Tompions to be put into the Muzzle of the Cannon.

13. House your Guns.

The Seizing is to be put on again upon the clinched End of the Breeching, leaving it no slacker than to admit of the Guns being housed with Ease. The Quoin is to be taken from under the Breech of the Gun, and the Bed, still resting upon the Bolt, within the Carriage, thrust under, till the Foot of it falls off the Axletree, leaving it to rest upon the End which projects out from the
Foot.

Foot. The Metal is to let down upon this. The Gun is to be placed exactly square, and the Muzzle is to be closed to the Wood, in its proper Place for passing the Muzzle-lashings.

14. Secure your Guns.

The Muzzle-lashings must be first made secure, and then with one Tackle (having all its Parts equally taut with the Breeching) the Gun is to be lashed. The other Tackle is to be bowled taut, and by itself made fast, that it may be ready to cast off for lashing a second Breeching.

N. B. Care must be taken to hook the first Tackle to the upper Bolt of the Carriage, that it may not otherwise obstruct the Reeving of the second Breeching, and to give the greater Length to the End Part of the Fall. No Pains must be spared in bowling the Lashing very taut, that the Gun may have the least Play that is possible, as their being loose may be productive of very dangerous Consequences. The Quoin, Crow, and Handspike, are to be put under the Gun, the Powder-horn hung up in its Place, &c.

Being engaged at any Time when there is a large Swell, a rough Sea, in squally Weather, &c. as the Ship may be liable to be suddenly much heeled, the Port Tackle-fall is to be kept clear and (whenever the Working of the Gun will admit of it) the Man charged with that Office is to keep it in his Hand; at the same Time the Muzzle-lashing is to be kept fast to the Ring of the Port, and being hauled taut, is to be fastened to the Eye-bolt, over the Port-hole, so as to be out of the Gun's Way in firing, in order to haul it in any Time of Danger.

This Precaution is not to be omitted, when engaging to the Windward any more than when to the Leeward, those Situations being very subject to alter at too short a Warning.

A Train-tackle is always to be made Use of with the Lee Guns, and the Men stationed to attend it are to be very careful in preventing the Gun's Running out an improper Time.

How to Form the Line.

THE next Thing thought necessary, is to give the young Officer an Idea of forming the Line, which is that Arrangement or Order, in which a Fleet of Ships of War are disposed to engage an Enemy.

The Disposition, which is the best calculated for the Operations of naval War, is formed by drawing up the Ships in a long File or Right-line, prolonged from the Keel of the hindmost to that of the foremast, and passing longitudinally through the Keels of all the

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the others from the Van to the Rear, so that they are, according to the Sea Phrase, in the Wake of each other.

In this Line or Order of Battle, all the Ships of which it is composed are close hauled upon the starboard or larboard Tack, about 50 Fathoms distant from each other.

A Fleet is more particularly drawn up in the Line when in Presence of an Enemy. It ought to be formed in such a Manner as that the Ships should mutually sustain and reinforce each other, and yet preserve a sufficient Space in their Stations to work or direct their Movements with Facility, during the Action. Thus they will be enabled effectually to cannonade the Enemy without incommoding the Ships of their own Squadron.

The Line close hauled is peculiarly chosen as the Order of Battle, because if the Fleet, which is to Windward, were arranged in any other Line, the Enemy might soon gain the Weather-gage of it; and even, if he thinks it expedient to decline that Advantage, it will yet be in his Power to determine the Distance between the adverse Fleet in an Engagement, and to compel the other to Action. The Fleet to Leeward being in a Line close hauled, parallel to the Enemy, can more readily avail itself of the Change of the Wind, or of the Neglect of its Adversary, by which it may, by a dextrous Management, get to Windward of him; or should he fail in his Attempt it will nevertheless be enabled, by the favourable State of the Wind, to avoid coming to Action if the Enemy is greatly superior, or to prevent him from escaping, if he should attempt it.

Besides these Advantages, this Order of Battle is singularly convenient and proper in other Respects. The Sails of each Ship are disposed in such a Manner as to counteract each other, so that the Ships in general neither advance nor retreat during the Action. By this Circumstance they are enabled to retain their Stations with greater Stability, and to prosecute the Battle with Vigour and Resolution, yet without Perplexity and Disorder. The Uniformity of the Line will be preserved, so that the Admiral's Orders may be readily communicated by Signals from the Van to the Rear. The Distress of any particular Ship that is disabled, and rendered incapable to continue the Action, will be presently discovered, and her Place accordingly supplied by one of the Ships in Reserve. The Circumstances and Situation of the Enemy's Line will be ever open to the View of the Commander in Chief, so that he may be enabled to convert any Disaster that may happen therein to his own Advantage.

It may be alledged, indeed, that the same Reasons hold good with Regard to the Enemy to whom this Arrangement will be equally beneficial. It may also be observed, that particular Occasions have rendered it necessary to break the Order of the Line, and that sometimes this Expedient has been practised with equal Judgment and Success. To the first of these Allegations it may be answered, that
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in War, as well as in Politics, there are certain general Rules absolutely necessary to be observed by the hostile Powers: Rules which are founded on mutual Convenience, and authorized by the invariable Example of all Ages. Whatever tends to facilitate the Designs of the adverse Parties on each other, or whatever operates to shorten the Period of War, and render it less destructive and fatal, are Objects which ought never to be disregarded. Disorder has not only a Tendency to protract the War, but to make it more bloody and ruinous, and to aggravate all the Calamities with which it is inseparably attended. Perhaps this Observation is particularly applicable to our present Purpose, unless the Consequences of Disorder in a Sea Fight, as related above, should rather be considered as the Creation of Fancy than a Recital of Facts naturally resulting from known Causes. Although peculiar Circumstances have sometimes, by their Success, justified the Measure of engaging an Enemy's Fleet without forming the Line; or after the Line has been separated; there is nevertheless very few Operations in War that require greater Delicacy and Vigilance, if the hostile Fleets are very near to each other. Perhaps no military Enterprize can be attended with greater Hazard, or with fewer Hopes of Success. The incessant Fire of so large an Assembly of Ships, in a very short Time covers the Scene of Action with a Cloud of Smoke, which is constantly accumulating. The Winds that enable the two Fleets to approach each other are soon become extremely feeble, or perhaps perfectly lulled, by the Explosions of a vigorous Cannonade: They are of Course incapable any longer to dissipate the Smoke, which then darkens the Air, and is almost impenetrable to the Eye.

If in this Situation the hostile Ships are promiscuously scattered among each other, it is easy to foretel the Mischiefs, Perplexity, and Distraction to which the Whole will be inevitably exposed. Not only is the most comprehensive Skill of the Commander in Chief rendered useless; the smaller Ships, abandoned to their ill Fortune, may be tore to Pieces by superior Force without Relief or Succour: And what is infinitely worse than all, the Ships of the same Fleet may cannonade each other, with all the Resolution and Spirit which they exert against their Enemies. If the Design of War is Conquest, and not Massacre, it is thus totally perverted. The Battle, instead of being brought to a speedy Issue, and decided by a Victory and Defeat, is unhappily protracted into a Scene of Slaughter and Ruin, equally fatal and decisive to both Parties.

If then Disorder and Confusion are fraught with such dangerous Consequences in a naval Armament, it is no less certain that the principal Sinews of its Strength are discipline, Regularity, Vigilance, and Activity. It has been already remarked, that the Ships of the Line should be sufficiently close to sustain each other; for if they are farther apart than those of the Enemy's Line, many single Ships will suffer the Fire of two at once. Hence the Fleet

is rendered inferior to that of the Enemy at the Onset of Battle; a Circumstance which evinces the Superiority of larger Ship's accompanied with weightier Metal. The Enemy is defeated by the Efforts of a more numerous and more powerful Artillery.

Besides these Advantages, the larger Ships are in other Respects highly preferable in a Line of Battle; they overlook those of an inferior Rate, which are accordingly laid open to the Fire of their Musquetry. In a high Sea they can more safely employ the Artillery of their lower Deck than a smaller Ship, and if both are obliged to shut their Lower Deck Ports, the Advantage of the three-decked Ships, with regard to their Cannon, will yet be considerable. They have three Tiers against two, and two against one; the same Superiority subsists in case they are dismasted, or when the upper Deck is incumbered with the Ruins.

The large Ships, being higher between Decks, are less incommoded with the Smoke, and their Cannon are managed with greater Facility.

The large Ships, having greater Solidity of Frame are better calculated to resist the Effects of Battle and Tempest. In general also they sail better than the small ones, except in fine Weather; for in a fresh Wind, when the Sea becomes agitated, they have always a Superiority.

The Fire-ships do not succeed so well against large Ships as the smaller ones; the Artillery will sink them or oblige them sooner to relinquish their Design, and they are easily towed away by the great Long-boats.

The Line of a Fleet, which has abundance of capital Ships, need not be so much inclosed as that of an Enemy who has fewer. The former may be also less numerous without being weaker.

An open Line will, on many Occasions, work more easily than one which is more inclosed; and, if it is less numerous, the Movements thereof are more expeditious, the Signals better attended, the general Order more exactly preserved, and the Ships less liable to be separated. Hence it will be less embarrassed by a Change of Wind, and the Order will be sooner re-established.

A less numerous Line will more readily approach or escape from an Enemy or a hostile Shore; and, finally, when cruising in a smaller Space, it will not be so much contracted.

From the preceding Reflections it results, that the Line which contains more capital Ships will be stronger than one more numerous if composed of smaller Ships. This Reflection, however, does not exclude a certain Number of the third and fourth Rates, which is necessary in all naval Armaments.

As the hostile Fleets are drawn up in two opposite Lines, with their Sides to the Wind, it is evident that one must be to the Lee-ward of the other. Both Situations, however, have their Defects as well as Advantages.

The Advantages of a Weather-line are generally, that it may approach

approach the Enemy so as to determine the Time and Distance of Action. If it is more numerous than the Lee-line, it may easily appoint a Detachment to fall on the Van and Rear of the latter, and inclose it between two Fires. It is little incommoded by the Fire or Smoke of the Cannon, and may dispatch the Fire-ships, under Cover of the Smoke, upon the disabled Ships of the Lee-line, or wheresoever they may occasion Perplexity and Disorder, by obliging the Enemy to break the Line and bear away.

The Weather-line has, nevertheless, its Defects, which sometimes counterbalance the Advantages above-recited. If the Sea is rough and the Wind boisterous, it cannot readily fight with the Lower-deck Battery: it cannot decline the Action without the dangerous Expedient of forcing through the Enemy's Line; and, if it keeps the Wind, the Lee-line may inclose and totally destroy it, especially if it is inferior in Number to the latter, or if the Ships thereof are in bad Condition; for it then can find no other Resource but in the Dexterity of its Manœuvres, unless it is favoured by Wind or any Oversight of the Enemy. The disabled Ships of the Weather-line must tack to avoid falling into the Enemy's Fleet; and if they are much shattered they may be altogether separated from their own Fleet, particularly if they are in the Rear of the Line.

The Line to Leeward has also its Advantages, which have occasionally been preferred to those of the Weather-line. The Ships of the former may use the Guns of their lower Decks, without the Hazard of taking in much Water at the Ports in stormy Weather; whereas the Line to Windward dares not open them without the greatest Danger. If the Lee line, although more numerous, cannot so easily double upon the Van and Rear of the Enemy, and inclose them between two Fires, it may nevertheless have Opportunities of tacking, and cutting off a Part of the Enemy's Rear, by obliging them to bear away or separate from the Rest. The disabled Ships to Leeward are much more readily removed from the Line than those to Windward, without being obliged to tack and continue exposed to the Enemy's Fire, they bear away and remain at a competent Distance from the Fleet in a State of Safety; finally, the Lee-line can with more Facility avoid the Action than its Adversary, a Circumstance which is extremely favourable to an inferior Squadron.

The Defects of the Lee-line, on the contrary, are, that it cannot decide the Time and Distance of the Battle, which may commence before it is sufficiently formed, and it will perhaps be attacked by an Enemy, who bears away upon it in regular Order. The Fire and Smoke of the Weather-line are a greater Inconvenience to it, and it cannot easily break the Enemy's Line with its Fire ships, which are very slowly and with great Difficulty conveyed to Windward.

It must be remarked, that the Admiral's Ship attentively preserves her Station in the Center of the Line; for if the Commander in

Chief should give Way to the Caprice or Inattention of any of those under his Direction, it would introduce an endless Disorder into the Squadron.

In an Engagement the Ships are generally brought to with the Main-top sails laid back, and their Fore-top sails full, for the Purpose of bearing away more readily when Occasion requires.

The Line is said to be formed a-breast when the Ship's Sides are all parallel to each other on a Line which crosses their Keels at Right Angles. This is more frequently used in pursuing or retreating, with the Wind right-aft, so that the Line forms a Perpendicular with the Direction of the Wind.

The Manner of an Engagement.

HAVING shown how to Form the Line, the next Thing necessary to be known is the Manner of an Engagement at Sea.

The whole Œconomy of a naval Engagement may be arranged under the following Heads; viz. the Preparation, the Action, and the Repair or Refitting for the Purpose of Navigation.

The Preparation is begun by issuing the Order to clear the Ship for Action, which is repeated by the Boatswain and his Mates at all the Hatchways, or Staircases, leading to the different Batteries. As the Management of the Artillery in a Vessel of War requires a considerable Number of Men, it is evident that the Officers and Sailors must be restrained to a narrow Space in their usual Habitations, in order to preserve the internal Regularity of the Ship. Hence the Hammocks, or hanging Beds of the latter, are crowded together as close as possible between the Decks, each of them being limited to the Breadth of fourteen Inches. They are hung parallel to each other in Rows, stretching from one Side of the Ship to the other nearly throughout her whole Length, so as to admit of no Passage, but by stooping under them; as the Cannon therefore cannot be worked while the Hammocks are suspended in this Situation, it becomes necessary to move them as quick as possible. By this Circumstance a double Advantage is obtained; the Batteries of Cannon are immediately cleared of an Incumbrance, and the Hammocks are converted into a Sort of Parapet, to prevent the Execution of small Shot on the Quarter-deck, Tops, and Forecastle. At the Summons of the Boatswain, "Up all Hammocks," every Sailor repairs to his own, and, having stowed his Bedding properly, he cords it up firmly with a Lashing, or Line provided for that Purpose. He then carries it to the Quarter-deck, Poop, or Forecastle, or wherever it may be necessary. As each Side of the Quarter-deck and Poop is furnished with a double Net-work, supported by Iron
Cranes,

Cranes, fixed immediately above the Gunnel, or Top of the Ship's Side, the Hammocks thus corded are firmly stowed by the Quarter-master between the two Parts of the Netting, so as to form an excellent Barrier; the Tops, Waist, or Forecastle are then fenced in the same Manner.

Whilst these Offices are performed below, the Boatswain and his Mates are employed in securing the Sail-yards to prevent them from tumbling down when the Ship is cannonaded, as she might thereby be disabled, and rendered incapable of Attack, Retreat, or Pursuit. The Yards are now likewise secured by strong Chains, or Ropes, additional to those by which they are usually suspended. The Boatswain also provides the necessary Materials to repair the Rigging wherever it may be damaged by the Shot of the Enemy, and to supply whatever Parts of it may be entirely destroyed. The Carpenter and his Crew in the mean while prepare his Shot-plugs and Mauls to close up any dangerous Breach that may be made near the Surface of the Water, and provide the Iron-work necessary to resist the Chain pumps, in case their Machinery should be wounded in the Engagement.

The Gunner, with his Mate and Quarter-gunners, is busied in examining the Cannon of the different Batteries, to see that their Charges are thoroughly dry and fit for Execution, to have every Thing ready for furnishing the great Guns and small Arms with Powder as soon as the Action begins, and to keep a sufficient Number of Cartridges continually filled to supply the Place of those expended in Battle. The Master and his Mates are attentive to have the Sails properly trimmed according to the Situation of the Ship, and to reduce or multiply them, as occasion requires, with all possible Expedition. The Lieutenant visits the different Decks to see that they are effectually cleared of all Incumbrance, so that nothing may retard the Execution of the Artillery, and to enjoin the other Officers to Diligence and Alertness in making the necessary Dispositions of the expected Engagement, so that every Thing may be in Readiness at a Moment's Warning.

When the hostile Ships have approached each other to a competent Distance, the Drums beat to Arms, the Boatswain and his Mates pipe all Hands to Quarters at every Hatchway. All the Persons appointed to manage the great Guns immediately repair to their respective Stations. The Crows, Handspikes, Rammers, Sponges, Powder-horns, Matches, and Train-tackles, are placed in Order by the Side of every Cannon. The Hatches are immediately laid to prevent any one from deserting his Post by escaping into the lower Apartments. The Marines are drawn up in Rank and File on the Quarter-deck, Poop, and Forecastle. The Lashing of the great Guns are cast loose, and the Tompions withdrawn. The whole Artillery, above and below, is run out at the Ports, and levelled to the Point-blank Range ready for firing. The necessary Preparations being completed, and the Officers and Crew ready
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at their respective Stations to obey the Order; the Commencement of the Action is determined by the mutual Distance and Situation of the adverse Ships, or by the Signal of the Commander in Chief of the Fleet or Squadron. The Cannon being levelled in parallel Rows projecting from the Ship's Side, the most natural Order of Battle is evidently to range the Ships a-breast of each other, especially if the Engagement is general. The most convenient Distance is properly within the Point-blank Range of a Musket, so that all the Artillery may do effectual Execution.

The Combat usually begins by a vigorous Cannonade, accompanied with the whole Efforts of the Swivel-guns and the small Arms. The Method of firing in Platoons, or Volleys of Cannon at once, appears inconvenient in the Sea-service, and perhaps should never be attempted unless in the Battering of a Fortification. The Sides and Deck of the Ship, although sufficiently strong for all the Purposes of War, would be too much shaken by so violent an Explosion and Recoil. The general Rule observed on this Occasion throughout the Ship is to load, fire, and sponge the Guns with all possible Expedition, yet without Confusion or Precipitation. The Captain of each Gun is particularly enjoined to fire only when the Piece is properly directed to its Object, that the Shot may not be fruitlessly expended. The Lieutenants who command the different Batteries traverse the Deck to see that the Battle is prosecuted with Vivacity, and to exhort and animate the Men to their Duty. The Midshipmen second the Injunctions, and give the necessary Assistance, wherever it may be required, at the Guns committed to their Charge. The Gunner should be particularly attentive that all the Artillery is sufficiently supplied with Powder, and that the Cartridges are carefully conveyed along the Decks in covered Boxes. The Havock produced by the Continuation of this mutual Assault may be conjectured by the Reader's Imagination; battering, penetrating and splintering the Sides and Decks, shattering or dismounting the Cannon, mangling or destroying the Rigging, cutting asunder or carrying away the Masts and Yards, piercing and tearing the Sails, so as to render them useless, and wounding, disabling, or killing the Ship's Company. The comparative Vigour and Resolution of Assailants to effect these pernicious Consequences in each other generally determine their Success or Defeat. I say generally; because the Fate of the Combat may sometimes be decided by an unforeseen Incident, equally fortunate for the one and fatal to the other; the defeated Ship having acknowledged the Victory by striking her Colours, is immediately taken possession of by the Conqueror, who secures her Officers and Crew as Prisoners in his own Ship, and invests his principal Officer with the Command of the Prize until a Captain is appointed by the Commander in Chief.

The Engagement being concluded they begin the Repair; the Cannon are secured by their Breechings and Tackles with all convenient

nient Expedition. Whatever Sails have been rendered unserviceable are unbent, and the wounded Masts and Yards struck upon the Deck and fished or replaced by others. The standing Rigging is knotted, and the running Rigging spliced wherever necessary. Proper Sails are bent in the Room of those which have been displaced as useless. The Carpenter and his Crew are employed in repairing the Breaches made in the Ship's Hull by Shot-plugs, Pieces of Plank, and Sheet-lead. The Gunner and his Assistants are busied in replenishing the allotted Number of charged Cartridges to supply the Space of those which have been expended, and in refitting whatever Furniture of the Cannon may have been damaged by the late Action.

Such is the usual Process and Consequences of an Engagement between two Ships of War, which may be considered as an Epitome of a general Battle between a Fleet or Squadron. The latter, however, involves a greater Variety of Incidents, and necessarily requires more comprehensive Skill and Judgment in the Commanding Officer.

When the Admiral or Commander in Chief of a naval Armament has discovered an Enemy's Fleet, his principal Concern is usually to approach it, and endeavour to come to Action as soon as possible; every inferior Consideration must be sacrificed to this important Object, and every Rule of Action should tend to hasten and prepare for so material an Event. The State of the Wind and the Situation of his Adversary will, in some Measure, dictate the Conduct necessary to be pursued with regard to the Disposition of his Ships on this Occasion. To facilitate the Execution of the Admiral's Orders the whole Fleet is ranged into three Squadrons, each of which is classed into three Divisions, under the Command of different Officers; before the Action begins, the adverse Fleet is commonly drawn up in two Lines parallel to each other, and close hauled. We have endeavoured to explain the Propriety and Necessity of this Disposition in forming the Line; as soon as the Admiral displays the Signal for the Line of Battle, the several Divisions separate from the Columns, in which they were disposed in the usual Order of sailing, and every Ship crowds into its Station in the Wake of the next ahead, and a proper Distance from each other, which is generally about 50 Fathoms, is regularly observed from the Van to the Rear. The Admiral, however, will occasionally contract or extend his Line so as to conform to the Length of that of his Adversary, whose Neglect or inferior Skill on this Occasion he will naturally convert to his own Advantage, as well as to prevent his own Line from being doubled, a Circumstance which might throw his Van to the Rear into Confusion.

When the adverse Fleets approach each other, the Courses are commonly hauled up in the Brails, and the Top-gallant sails and Stay-sails furled. The Movement of each Ship is chiefly regulated by the Main and Fore-top sails and the Jib, the Mizzen-top sail
being

being reserved to hasten or retard the Course of the Ship; and, in fine, by filling or backing, hoisting or lowering it, to determine her Velocity.

The Frigates, Tenders, and Fire-ships, being also hauled upon a Wind, lie at some Distance ready to execute the Admiral's Orders, or those of his Seconds, leaving the Line of Battle between them and the Enemy. If there are any Transports and Store Ships attendant on the Fleet, these are disposed still farther distant from the Action; if the Fleet is superior in Number to that of the Enemy, the Admiral usually selects a Body of Reserve from the different Squadrons which will always be of Use to cover the Fire-ships, Bomb vessels, &c. and may fall into the Line in any Case of Necessity; these also are stationed at a convenient Distance from the Line, and should evidently be opposite to the weakest Parts thereof.

And here it may not be improper to observe, that Order and Discipline give additional Strength and Activity to a Fleet. If thus a double Advantage is acquired by every Fleet, it is certainly more favourable to the inferior, which may thereby change its Disposition with greater Facility and Dispatch than one more numerous, yet without being separated. When good Courage is equal to both, good Order is then the only Resource of the smaller Number. Hence we may infer that a smaller Squadron of Men of War, whose Officers are perfectly disciplined in working their Ships, may, by its superior Dexterity, vanquish a more powerful one, even at the Commencement of the Fight; because the latter, being less expert in Order of Battle, will, by its Separation, suffer many of the Ships to remain useless, or not sufficiently near to protect each other.

The Signal for a general Engagement is usually displayed when the opposite Fleets are sufficiently within the Range of Point blank Shot, so that they may level the Artillery with Certainty of Execution, which is near enough for a Line of Battle. The Action is begun and carried on throughout the Fleet in the Manner we have already described between single Ships; at which Time the Admiral carries lighter Sail, observing, however, to regulate his Motions by those of the Enemy. The Ships of the Line mean while keep close in their Stations, none of which should hesitate to advance in their Order, although interrupted by the Situation of some Ship a-head, which has negligently fallen a-stern of her Station.

Such is now the Practice of naval War that the necessary Order of Battle, and the Fabric of our Ships, very seldom permit the Assault of Boarding, unless in single Actions. No Captain ought, therefore, to abandon his Station in the Line under any Pretence whatsoever, unless his Ship is too much disabled to continue the Combat. The small Quantity of Sail carried on this Occasion will permit the Bulk of the Fleet, although somewhat impaired, to continue their Cannonade a long Time without quitting the Line.

An Ambition to distinguish himself should never seduce any Captain to break the Line, in order to achieve any distant Enterprize, however the Prospect may flatter him with Success. He ought to wait the Signal of the Admiral, or his Commanding Officer; because it is more essential to preserve the Regularity of a close Line, which constitutes the principal Force of the Fleet, than to prosecute a particular Action, which, although brilliant in itself, has seldom any material Consequences, unless its Object is to seize a Flag-ship; and even this can only be justified by Success.

The various Exigences of the Combat call forth the Skill and Resources of the Admiral, to keep his Line as complete as possible, when it has been unequally attacked, by ordering Ships from those in Reserve to supply the Place of others which have suffered greatly by the Action, by directing his Fire-ships at a convenient Time to fall aboard the Enemy, by detaching Ships from one Part of the Line or Wing, which is stronger, to another which is greatly pressed by superior Force, and requires Assistance. His Vigilance is ever necessary to review the Situation of the Enemy from Van to Rear, every Motion of whom he should, if possible, anticipate and frustrate. He should seize the favourable Moments of Occasion, which are rapid in their Progress, and never return; far from being disconcerted by any unforeseen Incident, he should endeavour, if possible, to make it subservient to his Designs. His Experience and Reflection will naturally furnish him with every Method of Intelligence to discover the State of his different Squadrons and Divisions, Signals of Enquiry, and Answers of Request; and Assent of Command and Obedience, will be displayed and repeated on this Occasion. Tenders and Boats will also continually be detached between the Admiral and the Commanders of the several Squadrons or Divisions.

As the Danger presses on him, he ought to be fortified by Resolution and Presence of Mind, because the whole Fleet is committed to his Charge, and the Conduct of his Officers may, in a great Degree, be influenced by his Intrepidity and Perseverance. In short, his Renown or Infamy may depend on the Fate of the Day.

If he conquers in Battle, he ought to prosecute his Victory as much as possible, seizing, burning, or destroying the Enemy's Ships. If he is defeated, he should endeavour, by every Resource his Experience can suggest, to save as many of his Fleet as possible, by employing his Tenders, &c. to take out the wounded and put fresh Men in their Places, by towing the disabled Ships to a competent Distance, and by preventing the Execution of the Enemy's Fire-ships. In order to retreat with more Security, he may range his Fleet into the Form of a Half-Moon, placing himself in the Center; by this Disposition, the Enemy's Ships which attempt to fall upon his Rear, will at once expose themselves to the Fire of

the Admiral and his Seconds in a disadvantageous Situation ; a Circumstance which will serve to facilitate the Escape of his own Ships, and retard the Pursuit of those of his Adversary.

If his Fleet is too much extended by this Arrangement, the Wings or Quarters are easily closed, and the Half-moon rendered more complete, in the Midst of which may be placed his Store-ships, Tenders, &c. In flying or retreating, the Uncertainty of the Weather is to be considered ; it may become calm, or the Wind may shift in his Favour. His Schemes may be assisted by the Approach of the Night, or the Proximity of the Land, since he ought rather to run the Ships on Shore, if practicable, than suffer them to be taken afloat, and thereby transfer additional Strength to the Enemy. In short, nothing should be neglected that may contribute to the Preservation of his Fleet, or prevent any Part of it from falling into the Hands of the Conqueror.

By what we have observed, the real Force or Superiority of a Fleet, consists less in Number of Vessels and the Vivacity of the Action, than in good Order, Dexterity in working the Ships, Presence of Mind and skilful Conduct in the Captains.

The Stratagem of boarding is chiefly practised by Privateers upon Merchant-ships, who are so well provided with Men, and rarely attempted in the Royal Navy ; the Battle being generally decided in Men of War, by the vigorous Execution of a close Cannonade.

An Officer should maturely consider the Danger of boarding a Ship of War, before he attempts it, and be well assured that his Adversary is weakly manned ; for perhaps he wishes to be boarded, and if so, a great Slaughter will necessarily follow.

The swell of the Sea ought also to be considered ; because it may run so high as to expose both the Ships to the Danger of sinking.

There is, perhaps, very little Prudence in boarding a Ship of equal Force, and when it is attempted it may be either to Windward or to Leeward, according to the comparative Force or Situation of the Ships ; if there be any Swell or Sea it may be more adviseable to lay the Enemy aboard on the Lee-side, as the Water is there the smoothest ; besides, if the Boarder is repulsed, in that Situation he may more easily withdraw his Men, and stand off from his Adversary ; but as the Weather-ship can generally fall to Leeward at any Time, it is perhaps more eligible to keep to Windward, by which she will be enabled to rake her Antagonist, and fire the Broadside into her Stern, as she crosses it in passing to Leeward, which will do great Execution amongst her Men, by scouring the whole Length of the Deck.

Boaring may be performed in different Places of the Ship, according to the Circumstances, Preparation, and Position of both the Assailants, having previously selected a Number of Men armed with Pistols and Cutlasses, a Number of Powder-flasks or Flasks, charged

charged with Gunpowder, and fitted with a Fuse, are also provided to be thrown upon the Enemy's Deck, immediately before the Assault. Besides this, the Boarder is generally furnished with an earthen Shell, called a Stink-pot, which, on that Occasion, is suspended from his Yard-arms or Bow-sprit end. The Machine is also charged with Powder mixed with other inflammable and suffocating Materials, with a lighted Fuse at the Aperture. Thus prepared for the Action, and, having grappled his Adversary, the Boarder displays his Signal to begin the Assault; the Fuses of the Stink-pot and Powder-flasks being lighted, they are immediately thrown upon the Deck of the Enemy, where they burst and catch Fire, producing an intolerable Stench and Smoke, and filling the Deck with Tumult and Distraction; amidst the Confusion occasioned by this infernal Apparatus, the Detachment provided rush aboard Sword in Hand, under Cover of this Smoke, on their Antagonist, who is in the same Predicament with a Citadel stormed by the Besiegers, and generally overpowered, unless he is furnished with extraordinary Means of Defence, or equipped with Close-quarters, to which he can retreat with some Probability of Safety.

Close-quarters are strong Barriers of Wood, stretching across a Merchant-ship in several Places. They are used as a Place of Retreat when a Ship is boarded by her Adversary, and are therefore fitted with several small Loop holes, through which to fire the small Arms, whereby the Ship's Crew may defend themselves, and annoy the Enemy. They are likewise furnished with several small Caissons, called Powder-chests, which are fixed upon the Deck, and filled with Powder, old Nails, &c. and may be fired at any Time from the Close-quarters upon the Boarders.

The Manner of Surveying Sea Coasts and Harbours.

IT is a general Complaint among Seamen, that few Sea Charts are found correct; and this perhaps may be owing to the Manner of surveying the several Coasts, and copying from old Sea Charts; but as the Longitude of Places can now be better ascertained than formerly, it is hoped more accurate Maps will be made, as they are so very essential to the Mariner; who may, from the following Hints, either correct the Charts that are extant, or make new ones of his own, of those Parts he may have Occasion to sail by, or touch at.

From what has been already said in Oblique Sailing, an intelligent Reader may see how the Business of taking the Bearing of Part of a Coast, and of plotting or delineating it might be done; but as there are some Particulars which can be gained only by experience in the Art of Surveying, it may not be improper to apprize the Learner of them, and thereby qualify him to go more readily to work.

To take the Draught of a Coast in Sailing along it.

1st. Having brought the Ship to a convenient Place, from whence the principal Points of the Coast or Bay may be seen, either cast Anchor, if it is convenient, or lie to as steady as possible; or if the Coast is too shoal, let the Observations and Measures be done in a Boat: Then, while the Vessel is in a stationary Situation, take with the Azimuth Compass, the Bearings, in Degrees, of such Points of the Coast as form the most material Projections or Hollows; write down these Bearings, and make a rough Sketch of the Coasts, observing carefully to mark the Points whose Bearings were taken with Letters, for the sake of Reference.

Then let the Ship or Boat run in a direct Line, which must be very carefully measured by the Log or otherwise, one, two, or three Miles, more or less, until she comes into a Situation from whence the same Points before observed can be seen again; there let the Vessel lie steady as at the foregoing Station; and again observe the respective Bearings in Degrees of the same noted Points, which are also to be wrote down, and a rough Sketch of the Coast should also be taken from this Station; for which Purpose prepare an Observation Table, in which write distinctly and regularly the several celestial Observations, Bearings, Distances measured by the Log-line; the Rocks, Shoals, Soundings, Overfalls, Races of Tides, and other Remarks, that may be made along the Coast. The Table may consist of seven or eight Columns, disposed in the following Order:

NOTE. The Sextant will be found the readiest and most correct Instrument to take the Angles by, held in an Horizontal Position, by which Means any two Objects, not exceeding 120° , may be brought into Contact.

Observations in Navigating the Coast of ———, from Cape ———, to Point ———, being ——— Miles, measured by the Log, the Course from Station I. to II. being S. $\frac{1}{4}$ W.

Year, Month and Day.	Meridian Altitude of Sun.	Bearings at Station I.	Time and Distance sailed from Station I.	Bearings and Distances taken at these Distances.	Bearing of Rocks, Shoals, and their estimated Distances, when on a Line with the Points or Heads of the Coasts.	Remarks on the Tides and the Nature and Dimensions of Rocks, Shoals, and Anchorage
	D. M.		H. M. Mi.	Fath.	Points and Heads.	M.
1775, June 21st.		A. W. 27° N. a. W. 14 S.	1 27 $\frac{1}{4}$ 11 45 5	A. N. 5° W. B. W. 20 S. 22	C. and Rock W. 9° N. d. and Hill S. 19° W. 3 $\frac{1}{2}$	This Rock is dry at low Water and seemed 100 Yards in Length from N. W. to S. W. a leading Mark to it is.—

While the Vessel is running the Base Line from Station to Station, a more accurate Appearance of the Coast should be made. To do which, let four expert Persons be appointed; one to take the Bearing exactly with the Azimuth Compass; one to oversee the running out of the Log-line, and to keep an Account of the Ship's Way, so as to be readily able to tell the Distance run when required; the third to attend the Heaving of the Lead, to write down the Soundings and Bearings of one or two Head Points, or remarkable Parts of the Coast taken at each Depth: the fourth a Draughtsman, to draw out the necessary Bearings and Distances, and delineate the Figure and Windings of the Coast at each Station, and to correct

correct their Forms and Dimensions while the Ship is sailing along the Land. Then let the several Bearings be corrected by the Variation to reduce them to their true Positions. Then,

In some convenient Part of a Sheet of Paper, describe a Circle, the larger the better, on which lay off the several Bearings taken from the first Station, and let them be numbered 1, 2, 3, &c. on the Outside of the Circle: Also, lay down the several Bearings taken at the second Station; let these be numbered 1, 2, 3, &c. on the Inside of the Circle, observing, that the Bearings of the same Points are numbered with the same Figures.

Draw a Line to express the Ship's Run both in Length and Course; and from that End of the Line expressing the first Station, draw Lines parallel to the respective Bearings taken at that End, and note it on the Inside of the Circle; mark the Intersection of each Pair of Lines, directed to the same Point with the Number annexed to their Bearing; and through the Intersection so marked, draw by Hand a curved Line, observing to wave the Line in and out, as near as can be like the Bending of the Coast itself.

Against each Part draw the Appearance of the elevated or low Ground in the Sketches, distinguishing Rocks, Cliffs, or High Land, Low Land, Sand Hills, &c. If there are any Currents or Eddies, express them in their proper Places by Darts or Arrows, the Points being turned that Way the Current sets. Put in the several Soundings at Low-water in small Figures, distinguishing whether Fathoms or Feet, shew the Time of High-water, on the Full and Change Days, by Roman Figures, and tell the Rise in Feet: Put in a Compass, with a Scale of Miles or Leagues, such as the Vessel's Run was laid down by; add the Name of the Place, the Coast, and the Latitude and Longitude, as true as can be obtained.

If there is a Shoal or Sands on the Coast, let it be taken by a Boat sailing round it, and keeping an Account of the Courses, Distances, and Soundings; but to put in the Draught, the Boat must from some Part of the Sand or Shoal, take the Bearings of two Points on the Coast, whose Bearings have been taken from the Ship: Or the Bearing of the Boat at some Part of the Shoal, or of some Beacon in that Place, must be taken by the Ship, at the Stations where she takes the Bearings of the Shore; for by either of these Means, one Point of the Sand being obtained, the rest of it can be laid down from the Boat's Account.

If the Coast to be drawn is a Bay or Harbour, winding in such a Manner that all its principal Points cannot be seen at two Stations, let as many Bases or Lines be drawn, and exactly measured, as may be found necessary; observing, that the several Distances run should join to one another in the Nature of a Traverse; that each new Set of Objects or Points observed, should be taken from two Stations at the End of a known Distance; and that the Objects whose Bearings are
taken,

taken, do not extend so much beyond the Limits of the Base, as to make Angles with it of less than about $\frac{1}{2}$ or $\frac{3}{4}$ of a Point, but rather reserve such Objects for the next measured Base; for when Lines lie very oblique to one another, their Intersections are not easily ascertained.

If any particular Parts of the Harbour cannot be conveniently seen from either of the Stations, take the Boat into those Places, and having well examined them, make Sketches thereof, estimating the Length and Breadth of the several Inlets, either by the rowing or sailing of the Boat, taking as many Bearings, Soundings, and other Notes, as may be thought necessary; then annex these particular Views in their proper Places in the general Draught.

If there are any dangerous Sands or Rocks, besides inserting them in their proper Places, there should be a double Line drawn through that Point, or one or more Objects ashore; and for this Purpose chuse a Church, Mill, House, noted Tree, a Clift, or any remarkable Thing that can be distinctly seen at Sea, and which can be brought to bear in the same right Line with the Point to be avoided; but if that Point is under Water, there must be two Land Marks brought to bear with the Danger, either in a right Line, when it can be, or in two Lines; and that those two Lines, and that those Land Marks may be put down in their proper Places, their Bearing must also be taken from two of the Ship's Stations.

It should be remarked in the Draught what Places, if any, are unfit for Anchorage, and what are fit, by writing "rocky Ground, foul Anchorage, good Anchorage;" and in the latter, to draw the Figure of an Anchor. Also, if there is any particular Channel more convenient to sail through than another, it is to be pointed out by Lines drawn to its Entrance, from two or more noted Marks ashore.

The foregoing Method of surveying a Coast supposes in general, that it is taken by a Ship in her Passage along, not having an Opportunity of going ashore. But when Circumstances will permit the Measures and Observations to be made on Land, the Survey can be taken more accurately than on the Water.

To Survey an Harbour by Observation on Shore.

Make an Eye-Draught of the Place to be surveyed; and in going round its Coast fix in the most remarkable Points and Bends of the Shore Station Staves, or strait Poles, tall enough to be seen at a considerable Distance: But if at any of these Places there is a noted Tree, House, or any other remarkable Thing, that Object may serve instead of a Station Staff; and it will be convenient to black the Staves, and tie a Piece of white Bunting to the Top of each: Then in the Eye-Draught put Letters at the noted Points, or Marks, for Distinction sake.

Chuse

Chuse the most level Spot of Ground, wherein a base Line may be measured, of one or more Half Miles in Length, or a Length of not less than a tenth Part of the Distance of the two extreme Objects marked for observing, and let the Direction of the measured Base Line be so laid out, that from both Ends of it as many as possible of the Station Staves before planted, or the Objects before remarked, may be seen. The Bearing or Position of this Base must be well determined by Degrees and Minutes; and also its Length must be accurately measured to Feet and Parts, either by a measured Chain, or by a Piece of Log-line of 100 Feet long, properly marked at the End of every 10 Feet, and each End Length marked at every Foot.

From one End of the Base observe (with any Instrument proper to take Bearings) the Position or Bearing in Degrees and Minutes, of all the Staves or Objects within View, and write them down orderly; do the same from the other End of the Base, and let all the Bearings be corrected by the Variation of the Compass.

Then, these Measures and corrected Bearings being plotted or laid down, will give the most conspicuous Points of the Shore; the intermediate Spaces are to be filled up from the Sketches of them made on the Spot.

But if any of these Objects should spread on either Hand so far beyond the Limits of the Base, that at either End thereof, the other End and those Objects or Staves should appear nearly in the same Direction, or to make Angles not exceeding about 10 Degrees: Or, if some of the remarked Objects can be seen from only one End of the Base, then let the Bearings of such Objects be taken from a Place whose Position has been determined from both Ends of the measured Base; or if there are several remarked Objects, which cannot be seen from neither End of the Base Lines, let the Bearings of such Objects be taken from each of two Points, whose Position has been taken from both Ends of the Base. Or, it may on some Occasions, be proper to chuse another Place, on which another Base of a convenient Length may be measured, and from the Extremities of which the Ends of the first Base may be seen; and also as many as can be of the remaining Objects which lay too obliquely for the first Base, or which could not be seen from it. In such Manner proceed, until the Bearings are taken of all the Points judged necessary for completing the Survey of the Limits of the Harbour.

If a Base of a sufficient Length cannot be measured in one right Line, it may be taken in two adjoining Lines, as the two Sides of a Triangle; the included Angle being accurately taken, and the Bearing of either Line.

When the Outlines or Limits of an Harbour, Bay, Road, &c. are delineated by the preceding Precepts; the Appearances of the Shores, with the adjacent remarkable Objects correctly drawn; a Compass, with the Variation and Scale properly fitted to the Plan; the

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the Isles, Rocks, Sands, &c. marked in their proper Places; the Settling and Drift of the Currents and Tides; the Times of High-water on the Days of Full and New Moon, with the Rise of Water at those Times, and whether whole Tide, and Tide and Part; the best anchoring Places, with their Soundings at Low-water, and the Winds open to them; the best Track, with the Soundings all the Way to those anchoring Places; the proper sailing Marks to avoid Dangers: the Winds, if any troublesome ones, which prevail, and at what Seasons; the Places where fresh Water can be got; the Name of the Place, the Country in; on what Sea; the Latitude and Longitude; a Sketch of the Appearance the Place makes at Sea upon a known Rhumb, and at an estimated Distance; and whatever else a judicious Seaman shall think proper to insert; then is the Plan fit for all nautical Purposes, and may be embellished with proper Colours, if necessary.

Sea Draughts taken according to the foregoing Precepts, and neatly drawn and coloured, besides the real use they may be of, cannot fail to recommend the young Mariner, who surveys and constructs them, to the Notice of his Superiors.

To reduce a Draught to a larger or smaller Scale.

With a Black Lead Pencil draw the Draught to be reduced all over with cross Lines, forming exact Squares: Draw the clean Paper for the Copy also over with the same Number of Squares, but their Sides larger or smaller in Proportion to the intended Size of the Scale; such as one-half, one-fourth, &c. of the Length of the other. Distinguish by a stronger Line and Mark with a Figure every fifth or sixth Row of Squares in both, so that the several corresponding Squares may be readily perceived; then, in each of the Squares of the Draught, draw, by the Eye, a Curve on the Paper similar to that in the Square in the Draught, till the Whole is copied, and then the Black-lead Lines may be rubbed out with Bread.

To find the Height and Distances of Objects at Sea.

When the Object is perpendicular, and the Distance to it can be measured, find the Angle of Altitude with a Quadrant, and measure the Distance to it as exact as possible, then you have the Angles and Base to find the Perpendicular; or, if you go backward or forward until the Angle of Altitude be 45° , the Distance between you and the Object will be the perpendicular Height.

E X A M P L E.

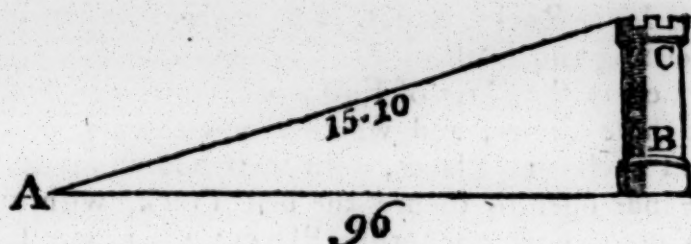
Being 96 Fathoms from the Bottom of a Tower, I find its Altitude (after allowing for the Height of my Eye above the Water) $15^{\circ} 10'$; required the Height?

K k

Draw

Draw $AB=96$,
upon B erect the
Perpendicular BC ,
and draw AC ,
making an Angle
with $AB=15^{\circ} 10'$
till it cuts BC

in C ; then will BC be the Height of the Tower 26.2.



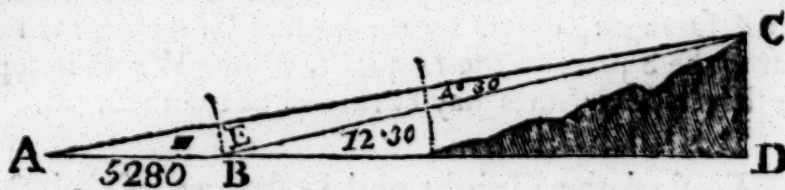
As Radius		10.00000
Is to the Dist. 96		1.98227
So is Tang. Ang.	$15^{\circ} 10'$	9.43308
To the Height	26.2	<u>1.41535</u>

When the Object is not perpendicular, such as Hills, Mountains, Rocks, &c. the perpendicular Height may be found by observing the Altitude at any convenient Distance, and then going either farther off, or nearer to it in a straight Line, and then observing the Altitude again. With these two Angles, and the Distance between the two Stations, being carefully measured, the perpendicular Height may be found either by Geometry or Trigonometry.

E X A M P L E.

Being at Sea, I observed the Altitude of a Mountain, and found it 8° ; and then sailing towards it in a direct Line 3 Miles, I found the Altitude of the same Mountain to be $12^{\circ} 30'$: Required the perpendicular Height?

Draw the
Base AD ,
and at A
make the
Angle DAC



$=8^{\circ}$ by drawing AC . Set off from A to B 3 Miles, or 5280 Yards, and at B make the Angle $DBC=12^{\circ} 30'$, by drawing the Line BC to cut the Line AC in C . From C . let fall the Perpendicular CD , which being measured, will give the perpendicular Height of the Mountain 2027 Yards. To find which by calculation:

Given the Angles $DAC=8^{\circ}$, and $DBC=12^{\circ} 30'$; then $12^{\circ} 30'$ subtracted from 180° leaves Angle $AEC=167^{\circ} 30'$, which being added to Angle $A 8^{\circ}$, the Sum $175^{\circ} 30'$, subtracted from 180° , leaves the Angle $ACB=4^{\circ} 30'$, whence we have the Angles; and one Side AB 5280 given, to find the Side AC ; then it will be

As

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As Sine Ang. BCA = $4^{\circ} 30' 8''$	89464	As Radius	10.00000		
Is to the Side AB	5280	3.72263	Is to Side AC	14570	4.16333
So is S. An. AEB = $167^{\circ} 30' 9''$	33534	So is Sine An. 8°			9.14355
	13.05797	To D C	2027	3.30688	
	8.89464	the perpendicular Height of the			
		Mountain.			
To the Side AC	14570	4.16333			

In like manner may the Height or Distance of any accessible or inaccessible Object be found, either at Sea or on Shore; and the Angles may be taken with a Quadrant, Semi-circle, &c.

NOTE. The Reason why Angle B is subtracted from 180° is, because that when a Right Line meets with another Right Line and makes Angles, the two Angles will be equal to 180° . (Eucl. I. 13.)

Of the Curvature of the Earth.

Most Persons know that if they are raised above the Surface of the adjacent Land or Water, they can not only see different Objects that lie on that Surface better, but also see those more and more remote as they advance higher. The Irregularity of the Surface of the Land will not be subjected to any one Rule that will give the Distance to which Objects may be seen at different Elevations; but at Sea, where there is generally an uniform Curvature of the Water, upon the Supposition of the spherical Figure of the Earth, those Distances may be easily computed.

RULE. To the Earth's Diameter add the Height of the Eye, multiply the Sum by that Height; then the Square Root of the Product is the Distance at which an Object on the Surface of the Water can be seen by an Eye so elevated; and by this Rule was the Table annexed computed, the Diameter of the Earth being taken at 41798117 Feet, according to Sir Isaac Newton's Measures. This Table may be usefully applied to estimate the Distance of an Object at Sea, the Elevation of that Object above its Horizon being known.

EXAMPLE I.

Sailing towards a Head-land, on which is a Light House, elevated 600 Feet above the Surface of the Water, we saw the Lights at Night just appearing in the Horizon. How far were we at that Time distant from the Light-House?

Look in the Table for 600 Feet, in the Column marked Height in Feet, and right against it, in the Column marked Distance in Miles, stands 29.994, so that the Distance may be reckoned about 30 Miles.

E X A M P L E II.

Being in Company with some Merchants walking on a sandy Shore, on the Look-out for a Vessel which was then expected, whose Top-gallant Mast was 140 Feet above the Surface, Allowance being made for her Immersion in the Water; we observed, through a Telescope, a Ship's Vane just appearing in the Horizon: How far off is that Ship, supposing it the Vessel expected?

ANSWER. Against 140 Feet, the Height stands 14.488, that is her Distance. Here is no Allowance made for the Height of the Eye above the Horizon; but it is obvious, that the higher the Eye the farther it can see. Now as Objects are seen in a straight Line, and that Line is a Tangent to the Earth's Surface, therefore, it follows, that to find the Distance of two elevated Objects, when the right Line joining them touches the Surface of the Earth between those Objects, look for the Distance answering to each Height, and their Sum is the Distance required.

Thus, in the second Example, suppose the Eye is raised six Feet above the Water's Edge, it can see an Object on the Surface 2.999, or 3 Miles off; this Distance added to the $14\frac{1}{2}$ Miles, makes the Distance of the Ship to be $17\frac{1}{2}$ Miles.

E X A M P L E III.

A Man being on the Main-top gallant Mast of a Man of War 200 Feet above the Water, sees an 100 Gun Ship she had engaged the Day before Hull to: How far were those Ships distant?

A Ship of 100 Guns, or a first Rate Man of War, is above 60 Feet from the Keel to the Rails; from which, deduct about 20 for the Draught of Water, leaves 40 Feet for the Height of her Quarter above Water: Now a Ship is seen Hull to, when her Upper Works just appear.

Then 200 Feet high gives	17.316 Miles.
And against 40 Feet stands	7.744 Miles.

Their Sum, which is	<u>25.060 Miles is their Distance.</u>
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To estimate Distances by Sound see OBLIQUE SAILING.

A T A B L E

A T A B L E for finding the Distance of Terrestrial Objects
at Sea.

Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.	Height in Feet.	Dist. in Miles.
1	1.224	53	8.914	240	18.969	760	33.756	2250	58.083
2	1.732	56	9.163	243	19.165	780	34.197	2300	58.725
3	2.121	59	9.405	250	19.360	800	34.633	2350	59.360
4	2.449	62	9.641	255	19.553	820	35.063	2400	59.988
5	2.738	65	9.872	260	19.743	840	35.488	2450	60.609
6	2.999	68	10.097	265	19.932	860	35.908	2500	61.225
7	3.239	71	10.317	270	20.119	880	36.323	2550	61.834
8	3.463	74	10.533	275	20.305	900	36.734	2600	62.437
9	3.673	77	10.745	280	20.489	920	37.140	2650	63.035
10	3.872	80	10.952	285	20.671	940	37.546	2700	63.626
11	4.061	83	11.156	290	20.851	960	37.938	2750	64.213
12	4.242	86	11.355	295	21.030	980	38.332	2800	64.794
13	4.415	89	11.552	300	21.208	1000	38.721	2850	65.370
14	4.581	92	11.745	310	21.558	1030	39.297	2900	65.940
15	4.742	95	11.932	320	21.903	1060	39.866	2950	66.507
16	4.898	98	12.121	330	22.243	1090	40.426	3000	67.068
17	5.048	101	12.306	340	22.578	1020	40.978	3050	67.625
18	5.195	104	12.487	350	22.907	1115	41.524	3100	68.177
19	5.338	107	12.666	360	23.232	1180	42.062	3150	68.725
20	5.476	110	12.842	370	23.553	1210	42.593	3200	69.268
21	5.611	113	13.016	380	23.869	1240	43.118	3250	69.807
22	5.743	116	13.188	390	24.181	1270	43.636	3300	70.342
23	5.872	119	13.357	400	24.489	1300	44.149	3350	70.873
24	5.999	122	13.525	410	24.793	1330	44.655	3400	71.400
25	6.122	125	13.690	420	25.094	1360	45.156	3450	71.923
26	6.243	128	13.853	430	25.391	1390	45.651	3500	72.443
27	6.362	131	14.015	440	25.684	1420	46.140	3550	72.958
28	6.479	134	14.174	450	25.974	1450	46.629	3600	73.470
29	6.594	137	14.332	460	26.261	1480	47.106	3650	73.979
30	6.709	140	14.488	470	26.545	1510	47.581	3700	74.484
31	6.817	143	14.642	480	26.826	1540	48.052	3750	74.985
32	6.928	146	14.795	490	27.104	1570	48.517	3800	75.484
33	7.034	150	14.995	500	27.379	1600	48.979	3850	75.979
34	7.140	155	15.241	510	27.652	1630	49.436	3900	76.471
35	7.244	160	15.488	520	27.922	1660	49.889	3950	76.959
36	7.347	165	15.728	530	28.189	1690	50.338	4000	77.445
37	7.448	170	15.965	540	28.454	1720	50.782	4050	77.927
38	7.548	175	16.198	550	28.716	1750	51.223	4100	78.407
39	7.647	180	16.427	560	28.976	1780	51.661	4150	78.884
40	7.744	185	16.654	570	29.233	1810	52.094	4200	79.358
41	7.840	190	16.876	580	29.486	1840	52.524	4250	79.829
42	7.935	195	17.098	590	29.742	1870	52.951	4300	80.297
43	8.029	200	17.316	600	29.994	1900	53.374	4350	80.762
44	8.122	205	17.531	620	30.489	1930	53.793	4400	81.215
45	8.214	210	17.744	640	30.976	1960	54.210	4450	81.665
46	8.305	215	17.955	660	31.457	2000	54.761	4500	82.113
47	8.394	220	18.160	680	31.930	2050	55.441	4550	82.598
48	8.483	225	18.366	700	32.396	2100	56.111	4600	83.051
49	8.570	230	18.569	720	32.855	2150	56.777	4650	83.501
50	8.658	235	18.770	740	33.309	2200	57.434	4700	83.919

An Explanation of the most useful Sea Terms.

AFT or *Abaft*. From the Head or Fore-part of the Ship towards the Stern, as carry such a Thing *abaft*; the Mast hangs *ast*, that is towards the Stern.

How chear ye fore and aft? That is, how chears all the Ship's Company.

Amain; that is, yield: A Term used by a Man of War to her Enemy.

Strike amain. Lower your Top-sails.

Avast. To stop.

Aloft, signifies over Head or above.

The Anchor is foul; that is, the Cable has got about the Fluke, which is the flat Point or Wing, that resembles the Head of an Arrow.

The Anchor is a-peak, or a-peek; signifying that it is directly under the Hawse or Hole through which the Cable of the Anchor runs out.

The Anchor is a cock bell; that is, it swings or hangs up and down by the Ship's Side.

An Awning is a Shelter or Screen that is made of a Sail, or such like, supported in the Nature of a Canopy over the Deck, to keep off the Heat of the Sun.

To bear with the Land, &c. that is, to sail towards it.

To bear-to, viz. To sail to a Channel or Harbour before or with the Wind.

Bring the Guns (or Ordnance) to bear; that is, point them right to the Mark.

Bear up; that is, to make the Ship sail more close to the Wind.

Belay. Make fast any running Rope.

Bend the Sails; that is, fasten or apply them to the Yards.

Her Sails are unbent, viz. has no Sails fixed.

Bend a Cable. Make it fast to the Anchor.

A Birth. A convenient Place to moor a Ship in.

A Bight, is any Part of a Rope between the Ends.

The Ship is bilged; that is, struck off some of her Timber on a Rock or Anchor and springs a Leak.

A Binacle or Bitacle, is that wherein the Compass stands.

To bit the Cable, is to put it round the Bits, which are two strong Pieces of Timber, in order to fasten it or slacken it gradually, which last is called veering away.

A Bonnet. An additional Part laced to the Bottom of the Main and Fore-sails in small Vessels in moderate Weather.

Board

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Board and Board, signifies that two Ships come so near as to touch each other.

To Board a Ship, is to enter in an hostile Manner, or against the Inclination of those in her.

Booms. Certain long Poles run out from different Places of the Ship, to extend the Bottom Sails.

Bow lines. Ropes fastened to the middle, leech, or perpendicular Edge of the Sails to keep them steady when the Ship is upon the Wind or plying to Windward.

Braces. Ropes used in Wheeling the Yards and Sails about according to the Direction of the Wind.

Preventer Braces. Temporary Braces, fixed occasionally to succour the Main or Fore Yard of a Ship, when they suffer an unusual Strain in a hard Gale of Wind.

Box-hauling. A particular Method of wearing a Ship when the Swell of the Sea renders Tacking impracticable.

Bouce. To pull upon any Rope.

Burton. A small Tack formed by two Blocks or Pullies till the Rope becomes three or four fold.

To break Bulk. To open the Hold and take Goods thereout.

A Buoy is a floating Cask or such like which is moored at a Sand-bank to warn Shipping against it; also is used to every Anchor in order to shew where the Anchor lies.

Careening, is bringing a Ship to lie down on one Side while the other is trimmed and caulked.

Cat and Fish. Machines used to draw up the Flukes of the Anchor towards the Top of the Bow in Order to secure it.

Capstern or Capstain, is a strong Column of Timber, with Holes in it to receive Levers or Bars, and fixed in the Deck, that the Men by turning it round horizontally may raise up the Anchor or any great Weight, and is secured by Pawls from recoiling.

Caulking, is driving Oakum or Spanhair, &c. into the Seams of a Ship to keep out Water

To cun a Ship, is to direct the Person at the Helm how to steer her.

If the Ship goes before the Wind, then the Pilot, or he who cuns the Ship uses these Terms to him that steers, according as the Case requires, viz. *Starboard*, that is to put the Helm to the Starboard, or Right Side, to make the Ship go to the Larboard, or Left Side; and so of the contrary. *Port*, is to keep the same Direction of the Helm upon the Starboard or Larboard, as has been last ordered. *Helm-a Midships* is to keep the Helm in a right line with the Ship's Head and Stern, neither inclining to Right or Left. In keeping the Ship near the Wind these Terms are used, viz. *Loof*, or *Luff*, *Keep your Luff*; *Fall not aft*; *Veer no more*; *Keep her to*; *Touch the Wind*; *Have a Care of the Lee-latch*. To make her go more large, they say, *Ease the Helm*; *No Near*; *Bear up*.

To

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To keep her upon the same Point they say, *Steady, thus, thus*; or, *As you go*; or such like. When she goes neither by a Wind nor before a Wind, but betwixt both, then they make Use of some of the following Terms, which are all of the same Signification, viz.

The Ship goes Lashing, Veering, or Large.

The Course, is that Point of the Compass on which the Ship sails.

What Course did you sail on? What Point of the Compass.

Courses signify the Ship's Sails; as, *She is under a Four-Course*; that is, sails with her Fore-mast Sails only. Under all her Courses is under all her Sails.

Cut the Sail, viz. unfurl it, and let it fall down.

Davit. A long Beam, used as a Crane for hoisting the Flukes of the Anchor to the Top of the Bow.

Dead-Water, signifies the Eddy-water at the Stern of the Ship.

The Ship drives, is when her Anchor gives Way.

Dolphin of the Mast. A peculiar Kind of Wreath formed of plaited Cordage.

Dunnage. A Quantity of loose Wood laid at the Bottom of the Ship to keep the Goods from Damage.

To hand or furl a Sail, is to wrap it up close together, and bind it up with little Strings, called *Caskets*, fast to the Yard.

To fish a Mast or Yard, is to fasten a Piece of Timber or Plank, by Way of Splinter, to the Mast-yard to strengthen it, which Piece or Plank is called a *Fish*.

To lower or strike the Flag, is to pull it down upon the Cap, and is either done in saluting with the utmost Respect, or in Token of yielding to an Enemy in Fight.

To fall, viz. To fall astern.

Fore, is forward. The Head of a Ship.

The Ship's Gage is so many feet as she sinks in the Water, or so many Feet as she draws.

Weather-gage, is when one Ship has the Wind, or is to the Weather of another

Goose Wings. The Clues, or lower Corner of a Ship's Main or Fore-sails, when the middle Part is furled or tied up to the Yard.

The Ship gries, viz. turns her Head to the Wind more than she should.

The Helm is hard a-Weather, that is, it is as hard to the Weather as it will go.

To hail a Ship; to call her Company, to know whither they are bound, &c. and is thus done: *Hoa the Ship*, or only *Hoa*; to which they answer *Hoa* likewise. To salute another Ship with Trumpets, &c. is called *Hailing*.

An Hawser, is the Cable belonging to the Anchor.

Clear the Hawse, is when two Cables that come through several Hawses are twisted, and are ordered to be untwisted or freed.

To

To kitch, is to make fast.

The Ship heels. She inclines more to one Side than the other; as

She heels to the Larboard, viz. inclines to the Larboard or Left Side.

The Hold of a Ship is the very lower Apartment or Division in the Bottom of the Ship betwixt the Keel and Lower Deck, where all Goods, Stores, &c. lie.

To rummage the Hold, is to overhaul the Goods in it.

To stow the Hold, is to place Goods, &c. in the Hold.

To hoist, is to haul or lift up.

The Ship labours; that is, rolls and tumbles much.

Land-fall, is expressing an Expectation of seeing Land.

Land locked, is when a Ship lies within a Bay or Creek, and sheltered all round by the Land, so that no Point is open to the View of the Sea.

To lash, signifies to bind.

To launch a Ship, is to put her forth off the Dock into the Water; but in some Cases it is used in a negative Sense, as

• *Launch her*, viz. Hoist no more, when a Yard is hoisted high enough, and that Orders are given to stop.

Lee-shore, is that against which the Wind blows.

She lies by the Lee; that is, a Ship has all her Sails lying flat against the Masts and Shrouds.

Leeward, is with the Wind, or on that Point towards which the Wind blows.

Lee-way, is the lateral Movement of a Ship to Leeward of her Course, or the Angle which the Line of her Way makes with the Keel when she is close hauled.

Looming. A distant Appearance of distant Objects at Sea, as Coasts, Ships or Mountains.

Mizen has several Words peculiar to it. The *Mizen-mast* is that which stands abaft or nearest to the Stern of the Ship; and from thence every Thing belonging to that Mast is distinguished accordingly, as are all the other Masts, their Rigging, &c. So therefore the *Mizen sail* is called the *Mizen*, and is thus understood, viz.

Set the Mizzen, that is, set the Mizzen-sail.

Change the Mizzen; bring the Yard to the other Side of the Mast.

Peek the Mizzen; that is, put the Yard right up and down the Mast.

Spell the Mizzen; let go the Sheet and peek it up.

To moor a Ship is to lay out her Anchors in such a Manner as she may most conveniently ride with Safety.

Neap Tides, are those Tides which are in the first and last Quarter of the Moon, and are not so high, so low, nor so swift as the Spring Tides.

The Offing, is to the Seaward from the Land.

To pay a Seam, is to lay hot Pitch and Tar on (after Caulking) without Canvass.

To ride a peak, is when the Yards are so ordered that they seem to represent a St. Andrew's Cross.

Preventer-braces. Temporary Braces, fixed occasionally to succour the Main or Fore-yards of a Ship, when they suffer an unusual Strain in a hard Gale of Wind.

To purchase an Anchor; that is, to loosen it so as to be able to haul it up.

The Capstern purchases a-pace, viz. Draws in the Cable a pace.

Puddering. A thick Reef or Circle of Cordage, tapering from the Middle towards the Ends, and fastened about Masts to prevent the Yards from falling down.

Quarter-Winds, are when the Wind blows in abaft the Main-mast Shrouds even with the Ship's Quarters.

A Quoil, is a Rope or Cable laid up round, one Fake over another; and the Fake is called Quoil.

A Range, is a sufficient Length of Cable drawn upon Deck before the Anchor is let go.

Rounding in, or pulling in several Ropes.

A Reach, is the Distance between any two Points of Land that lie in a right Line from each other.

To reeve, is to put a Rope through a Block; so, *Unreeving the Rope* is to pull the Rope out of the Block.

To ride. A Ship is said to ride at Anchor when she does not drive with the Wind or Tide, but is held fast by her Anchors.

To ride athwart, is to ride with the Ship's Side to the Tide.

To ride betwixt Wind and Tide, is when the Ship rides at Anchor, and the Wind and Tide are contrary and have equal Strength.

To rise Hawse-fallen, is when the Water breaks into the Hawses in a rough Sea.

A Road, is any Place near the Land where Ships may ride at Anchor, from whence a Ship so riding is called a Roder.

Rouce in, signifies to haul in, and is properly applicable only to the Hawser or Cable, in ordering it to be made straight, tight, or taut, when it is slack.

To serve a Rope, is to wind something about it to preserve it from chaffing or wearing.

A Service. The Thing wound about a Rope is so called.

To seize, is to make fast or bind.

She heels; that is, when on a sudden the Ship lies down on her Side, and tumbles from one Side to the other.

To settle a Deck, is to lay it lower.

Shank-painter. A short Rope and Chain which hangs the Shank and Flukes of the Anchor up to the Ship's Side.

The Ship sheers; that is, she goes in and out, and not right forward.

To sound, is to try with a Line or other Thing how deep the Water is.

The Ship has spent her Masts; that is, they have been broke by foul Weather;

Weather : But, if a Ship lose her Masts in Fight, it is then said, *Her Masts have been shot by the Board.*

To splice Ropes ; that is, to join two Ends of a Rope, or twist two Ropes together.

The sails are split ; that is, blown to Pieces.

Spring-Tides, are the Tides at New and Full Moon, which flow highest, ebb lowest, and run strongest.

The Bow-sprit steeves ; viz. stands too upright

Stoppers of the Cable, are short Ropes with a large Knot and a Laniard at one End, and are fastened to a Ring-bolt in the Deck by the other. They are attached to the Cable by the Laniard, which is fastened securely round both, by several Turns passing behind the Knot or Nick of the Stopper, by which Means the Cable is restrained from running out off the Ship when at Anchor.

Stream Buoy. A Buoy belonging to a small Anchor in the Ship.

Streaks, the uniform Ranges of Planks at the Bottoms or Sides of Ships.

Surge the Vial, is to slacken the Rope wound about the Capstern by which the Anchor is hove up.

Tack about ; that is, bring the Ship's Head about to lie the other Way.

Tally-ast the Sheets. A peculiar Term used for hauling ast the Sheets of a Main or Fore-sail.

A Windward Tide, is a Tide that runs against the Wind.

Tarpaulin. A Piece of Canvas, well daubed with Tar, to cover the Hatchway.

Tackle-fall, Ropes belonging to a Tackle.

A Leeward Tide, when the Wind and Tide go both one Way.

A Tide-gate is so called where the Tide runs strong.

Tombion. A Bung or Cork to stop the Mouth of the Cannon.

To Tide it up, is to go with the Tide against the Wind ; and on the Tide's altering, to lie at Anchor till it serves again.

It flows Tide and Half-tide ; that is, it will be High-Water sooner by three Hours by the Shore than in the Offing.

To tow ; that is, to drag any Thing after the Ship or Boat.

The Ship's Traverse, is her Way.

Veer. To pay out or let away more Rope or Cable ; the Wind is said to *veer* when it alters its Direction, and when a Ship changes her Course by turning her Stern to Windward, in Opposition to Tacking, wherein the Head is turned to Windward.

Wake, is the Point or Track impressed on the Water by a Ship's passing through it, leaving a Smoothness on the Sea behind it. A Ship is said to come into the Wake of another Ship when she follows her on the same Track, and is chiefly done in bringing Ships to, or in forming the Line of Battle.

To weather a Ship ; that is, to go to Windward of her.

To Wind a Ship ; viz. To bring her Head about.

How winds the Ship? that is, upon what Point of the Compass she lies with her Head.

To warp a Ship in or out of Harbour, is to carry her against the Wind by means of carrying out an Anchor in the Boat and dropping it; then to haul upon it, and so carry out another Anchor after the Ship is come nearly up to the first Anchor.

To would; that is, to bind Ropes about the Mast, or the like, to keep on a Fish, or strengthen it.

The Ship yaws; viz. She goes in and out, and does not steer steady.

Having in the preceding Sheets, treated of those Parts commonly taught in Schools, and practised at Sea, which, being well understood, may be thought fully sufficient for qualifying young Mariners; but, as some are ambitious of knowing late Improvements made in Navigation, we shall next proceed to the Solution of those two important Problems so long wished for; viz. The New Method of finding the Latitude by two Altitudes of the Sun, and the New Method of finding the Longitude at Sea, by taking the Moon's Distance from the Sun or fixed Star.

The New Method of finding the LATITUDE at SEA, by taking two Altitudes, either in the Forenoon, or Afternoon, having the intermediate Time measured by a common Watch, with Ease and Accuracy, independent of the Sun's Meridian Altitude.

GENERAL RULES:

TO the Arithmetical Complement of the Logarithm of the Co-fine of the Latitude by Account, add the Arithmetical Complement of the Co-fine of the Sun's Declination; call that Sum the Logarithm Ratio.*

From the Natural Sine of the greatest Altitude, subtract the Natural Sine of the least Altitude, and find the Logarithm of their Difference, and write it under the Logarithm Ratio.

Subtract the Hours and Minutes when the Altitudes were taken from each other, and Half the Difference call elapsed Time.

With Half the elapsed Time enter these Tables, and from the Column of Half-elapsed Time take out the Logarithm answering thereto, and set it down under the Logarithm Ratio.

* Or Secant less Radius, the Arithmetical Com. of the Co-Sine of any Angle is equal to the Logarithmic Secant of that Angle, omitting the first Figure in the Index: thus the Secant of $46^{\circ} 5'$ is 10.16487, and omitting the first Figure 1, leaves 0.16487, the Secant less Radius, the Arithmet. Com. of Co-Sine $46^{\circ} 50'$.

Add these three Logarithms together, and with their Sum enter the Tables in the Column of Middle Time, where, having found the Logarithm nearest thereto, take out the Time corresponding to it, and put it down under Half the elapsed Time.

Subtract the Less from the Greater, and the Difference will be the Time from Noon when the greatest Altitude was taken.

With this Time enter the new Tables, and from the Column of Rising, take out the Logarithm corresponding to it; from this Logarithm subtract the Logarithm Ratio, the Remainder will be the Logarithm of a Natural Number, which being found in any common Table of Logarithms, and added to the Natural Sine of the greatest Altitude, will give the Natural Sine of the Sun's Meridian Altitude.

Having the Meridian Altitude of the Sun at Noon, the Latitude is found by the usual Method.

N. B. If the Latitude, found by the above Process should differ widely from the Latitude by Account, it will be proper to repeat the Operation; using the Latitude last found instead of the Latitude by Account, till the Result gives a Latitude nearly agreeing with the Latitude used in the Computation.

E X A M P L E I.

Being at Sea in Latitude $46^{\circ} 50'$ North by Account, when the Sun's Declination was $11^{\circ} 17' N.$ at 10 H. 2 M. in the Forenoon, the Sun's Altitude was $46^{\circ} 55'$, and at 11 H. 27 M. in the Forenoon, the Second Altitude was $54^{\circ} 9'$. Required the true Latitude, and true Time of the Day when the greatest Altitude was taken?

Times.

H. M. S. Lat. $46^{\circ} 50'$ Arith. Co. of Co-sine 0,16487

11 27 0

10 2 0 Dec. 11 17 Arith. Co. of Co-sine 0,00848

Ela. T. 1 25 0

Added gives the Log. Ratio 0,17335

$\frac{1}{2}$ El. T. 0 42 30

The Sun's gr. Alt. at 11 H. 27 M. is $54^{\circ} 9'$ Its Nat. Sine 81055

The Sun's least Alt. at 10 H. 2 M. is $46^{\circ} 55'$ Its Nat. Sine 73036

The Remainder or Diff. of Nat. Sines 8019

Log. Ratio 0,17335

The Common Log. of the Diff. N. S. 80.19 3,90412

In the New Tables in Col. $\frac{1}{2}$ Ela. Time for 42 M. 30 S. is 0,73429

Their Sum of the Log. in Middle Time 4,81176

The

	H. M. S.
The H. M. &c. for which by the New Table is	1 15 30
Subtract Half elapsed Time	42 30
The Diff. is the true Space of Time the Sun had to rise to the Meridian when the greatest Altitude was taken	0 33 00

	H. M.
Time per Watch	11 27
Sub. from	12 0

0 33 Finding they agree the Watch is right.

Enter the Tables with 33 M. under Col. of Rising, and you will find the Log.	3,01488
From which subtract the Log. Ratio	0,17335
The Natural Number of which is 694	2,84153
To the Natural Sine of the greatest Alt.	81055
Add the Natural Number of the above Log	694
The Sum is the Natural Sine of the Sun's Meridian Altitude, 54° 50'	81749

90° 0'
54 50

The Sun's Zen. Dist.	35	10	By observing the Sun's Merid. Alt.
The Sun's Decl.	11	17	the same Day the Lat. was found to be 46° 28' N.

Lat.	46 27
------	-------

E X A M P L E II.

Being at Sea in Lat. 47° 19' N. by Account, when the Sun's Declination was 12° 16' N. at 10 H. 24 M. A. M. per Watch, the Sun's Alt. was 49° 9', at 1 H. 14 M. P. M. his Alt. was 51° 59'. Required the Latitude?

H. M. S.	Alt.	Nat.	S. Lat.	47° 19'	0,16880
10 24 0	49° 9'	75642	Sun's Decl.	12 16	0,01003
1 14 0	51 59	78783			17883
			Log. Ratio		3,49707
El. Ti.	2 50 0	Diff. N. S.	3141	Its Log.	
½ El. T.	1 25 0	Its Log. in Col. of	half Elap. Time is		0,44077
Sub.	0 15 0	Col. of Mid. Time	corresponding to		4,11667
Fr. Ti.	1 10 0				True

THE LATITUDE AT SEA. 271

True T. 1 10 0 Its Log. in Col. of Rising is 3,66542
T. p. W. 1 14 0 Log. Ratio Sub. 0,17883

Wat. fast 0 4 0 3066 the Nat. Num. of this Log. 3,48659

N. S. Sun's gr. Alt. 78783 90 00

N. S. S. Mer. Alt. 81849 = 54 56

Sun's Zen. Dist. 35 4
Sun's Decl. 12 16 N.

Lat. in 47 20 North.

Here the Latitude found by Computation may be relied on, as it differs but one Mile from that used in the Operation.

E X A M P L E III.

Being at Sea in Lat. 50° 40' North per Account, when the Sun's Declination was 20° 0' South, at 10 H. 17 M. A. M. per Watch, the Sun's Alt. was found 17° 13', at 11 H. 17 M. A. M. per Watch it was found 19° 41' Required the Latitude?

Times.	Alt.	Nat. S.	Lat. 50° 40'	0,19803
H. M S.			Decl. 20 00	0,02701
10 17 0	17° 13'	= 29599		
11 17 0	19 41'	= 33682	Log. Ratio	0,22504

Ela. T. 1 0 0 Diff. N. S. 4083 Its Com. Log. 3,61098

½ El. T. 0 30 0 Its Log. from Col. half Elap. Time is 0,88430

1 1 0 In Col. of Mid. Time correspond. to 4,72032

Tr. Tim. 0 31 0 From Nn. its Log. from Col. of Rif. 2,96067
T. p. W. 0 43 0 Log. Ratio Sub. 0,22504

W. flow 0 12 0 544 N. Num. of 2,73563
33682 N. S. greatest Alt.

0 90 0
20 1 34226 N. S. of Sun's Mer. Alt. 20° 1'

Zen. Dist. 69 59
Decl. 20 0 S.

Lat. 49 59 N.

But as this Latitude differs 41 Miles from that by Account, it will be proper to repeat the Operation, using the Lat. last found instead of the Lat. by Account.

Elapsed

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	H. M. S.	Lat.	49° 56'	0,19178
Elapsed Time	0 30 0	Decl.	20 0	0,02701
	1 0 0			
		Log. Ratio		0,21879
True Time	0 30 0			3,61098
Time per Watch	0 43 0			0,88430
		H. M.		
Watch slow	0 13 0	In Col. Mid. T.	1 0	4,71407
True Time	0 30 0	Its Log. in Col. of Rising is		2,93223
		Log. Ratio		0,21897
		517 Nat. Num. of		2,71344
		33682 Nat. S. gr. Alt.		

Nat. S. Sun's Mer. Alt. 34199 = 20° 0'

Zen. Dist. 70 0
Decl. 20 0 S.

The Lat. 50 0 North.

The Latitude last found, differing only one Mile from that used in the Operation, may be depended on as the Latitude. Hence it is plain, that the Operation is repeated with very little additional Trouble, but few Alterations being necessary.

E X A M P L E IV.

Being at Sea in the Latitude of 60° 0' North by Account, when the Sun was on the Equator, and consequently had no Declination, at 1 H. 0 M. P. M. per Watch, his Altitude was 28° 53', and at 3 H. 0 M. P. M. per Watch, it was 20° 42'. Required the true Lat.

Times			Lat. 60° 0' = 0,30103
H. M. S.	Alt. N. S.		Dec. 0 0 = 0,00000
1 0 0	28 53 = 48303		
3 0 0	20 42 = 35347	Log. Ratio	0,30103
Elap. T. 2 0 0	12956	Its Log.	4,11247
½ Elap. T. 1 0 0	Its Log in Col. of ½ Elap. Time		0,58700
2 0 0	Its Log. in Col. of Mid. T.		5,00050
T. fr. N. 1 0 0	Its Log. from Col. of Rising		3,53243
D. per W. 1 0 0	Log. Ratio		0,30103
	1704		3,23140
	48303		

Nat. S. Sun's Mer. Alt. 50007 = 30° 0' Sun's Meridian Alt.

60 0 Latitude

The

The Latitude by Computation, coming the same with the Latitude by Account, shews that the Latitude by Account was right. From the foregoing Examples it is plain, that the Operation is the same, whether the Sun hath North or South Declination. And it will be the same whether the Ship is in a North or South Latitude. It is also clear, that when the Sun has no Declination, the Arithmetical Complement of the Log. Co-Sine of the Latitude, is the Log. Ratio.

E X A M P L E V.

July 5th, 1786, wanting to go through the N. Channel among the Maldives, and by Account being Latitude $7^{\circ} 40' N.$ at 7 H. 25 M. 40 S. A. M. the true Altitude of the Sun's Centre was $22^{\circ} 30'$, and at 10 H. 31 M. 48 S. A. M. it was found $63^{\circ} 40'$. Required the Ship's true Latitude?

H. M. S.	Alt.	Nat. S.	Lat. by Ac. $7^{\circ} 40'$	0,00390
Times 10 31 48	$63^{\circ} 40'$	89623	D. July 5. 22 47	0,03528
7 25 40	$22^{\circ} 30'$	38268		
			Log. Ratio	0,03918
Elap. T. 3 6 8		51355	Its Log.	4,71058
$\frac{1}{2}$ El. T. 1 33 04			Its Log. in Col of $\frac{1}{2}$ Elap. Time is	0,40368
3 1 30			H. M. S.	
			3 1 30	5,15344
True T. 1 28 26			Its Log. in Col. of Rising is	3,86709
T.p.W. 1 28 12			Log. Ratio	0,03918
Wat. f. 0 0 14		6728	Nat. Num.	3,82781
	90 00	89623	Nat. S. gr. Alt.	
Mer. Alt.	74 29			
		96351	N. S. Sun's Mer. Alt. = $74^{\circ} 29'$.	
Zen. Dist.	15 31			
Decl.	22 47			
Lat. in	7 16		North.	

N. B. As the Tables are only calculated to 30 Seconds, the Log. for any intermediate Seconds is found by taking the Difference between the Log. next greater and next less, and saying, as 30 Seconds is to that Difference, so is the given Seconds to the Difference of the Logarithms; or, if it be any even Part, take such a Part of the Difference, and apply it to the next less Logarithm; but in these Operations a few Seconds are not regarded.

SECOND OPERATION.

Lat.	7° 16'	0,00350
Dec.	22 48	0,03528
	Log. Ratio	0,03878
H. M. S.		4,71058
3 1 30		0,40368
	H. M. S.	
1 33 0	3 1 30	5,15304
True Time 1 28 30		3,86700
N. S. gr. Alt. 89623	Log. Ratio	0,03878

6733 N. Nu. Log. 3,82822
 N.S. Sun's M. Alt. 96356 = 74 29. Hence the Lat. in is 7° 16' N.

The Latitude last found, agreeing with that used in the Operation, it may be taken as the True Latitude; and the Operation is repeated with very little additional Trouble, but few Alterations being necessary. Hence it is plain, that if you are mistaken in the Latitude by Account, yet by repeating the Work two or three Times, making Use of the Latitude last found in the next Operation, it will at last discover itself to be true, by being equal to the last Supposition, which evidently shews the Excellency of these new Tables.

In the former Examples we have considered both Altitudes taken at the same Place or Station; but, as that is seldom the Case at Sea, the necessary Correction for any Alteration of Station may be readily made as follows:

Suppose the first Altitude in the Forenoon at	H. M.
	10 26
The second Altitude in the Afternoon at 2 H. 43 M.	14 43
Difference of Longitude made is 30 Miles W. equal to	0 2
	14 41
	10 26

Subtracted is the elapsed Time

4 15

If a Ship has been sailing to the Eastward, the above two Minutes must be added; but unless the Difference of Longitude be considerable, it is not worth Notice, as it will make a very inconsiderable Error in the Latitude.

Again, if the Ship sails or makes towards that Point of the Compass which the Sun bears upon, she must raise the Sun's Altitude as many Minutes as the Miles she has run towards it; therefore the Miles run towards the Sun must be added to the first Altitude; but if sailing from the Sun, the same must be subtracted: If they are but few, they are not worth minding; and then the Seaman may make a very good Estimation by looking at the Log-board only, who, by that, will be able to ascertain the Distance sailed to, or from the Sun,

Sun, between the Observations, which will be of sufficient Exactness in the Practice of Navigation; and if the Ship makes an Angle with the Sun's Bearing, it may be readily found by the Table of Difference of Latitude and Departure, and then either add or subtract, according as the Case requires; as may be seen in the following Examples, which are inserted for the Benefit of those who require a greater Degree of Accuracy.

E X A M P L E VI.

On the 20th of December 1786, being in a Ship from the Bay of Biscay, bound to the English Channel, in a brisk Gale running N. by E. $\frac{3}{4}$ E. per Compass at the Rate of 9 Knots per Hour, at 10 H. 0 M. A. M. per Watch, observed the Sun's Altitude $13^{\circ} 18'$ bearing South $\frac{3}{4}$ E. by Compass, and at 1 H. 40 M. P. M. per Watch, the Sun's Altitude again was found $14^{\circ} 15'$, the Latitude by Account being then $49^{\circ} 17' N.$ required the true Latitude?

The Correction to the first Altitude.

The Time of the first Observation is 10 H. 0 M. A. M. and of the Second 1 H. 40 M. P. M. the Elapsed Time is 3 Hours 40 M. and the Rate of Sailing is 9 Miles per Hour; then say, by the Rule of Three, as 1 H. is to 9 Miles, so is 3 H. 40 M. to 33 Miles, the Distance run in the Elapsed Time.

Again, the Sun's Bearing at the first Observation is South $\frac{3}{4}$ E. the opposite Point to which is N. $\frac{3}{4}$ W. or $\frac{3}{4}$ Point, and the Ship's Course during the Elap. Time is N. by E. $\frac{3}{4}$ E. $1\frac{3}{4}$ Points, so the Angle of Ship's Course with the Sun's Bearing is $2\frac{1}{2}$ Points.

Now in the Table of Difference of Latitude and Departure, to the Course $2\frac{1}{2}$ Points, and Distance 33, the Difference of Latitude is 29, and the Ship is sailing from the Sun; therefore from the first observed Alt. $13^{\circ} 18'$ take 29', the Remainder $12^{\circ} 49'$, the first Altitude corrected, which is to be used in the Operation as follows:

	H. M. S.	Alt.	Nat. S.	Lat.	$49^{\circ} 17'$	0,18554
Times	10 0 0	$14^{\circ} 15' = 24615$		Decl.	$23^{\circ} 28'$	0,03749
	1 40 0	$12^{\circ} 49' = 22185$				
				Log. Ratio		0,22303
Ela. T.	3 40 0	Diff. N. S. 2430		Its Log.		3,38561
				Its Log.		0,33559
$\frac{1}{2}$ El. T.	1 50 0					
	0 10 0	Time corresponding to				3,94423
	1 40 0	Its Log. in Col. of Rising is				3,97170
				Log. Ratio		0,22303
	90 0	5606 Nat. Num. of				3,74867
	17 35	24615				
		M m 2				Zen.

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Zen. Dist. 72 25 N.S.M. Alt. 30221 = 17 35
Decl. 23 28

Lat. 48 57 N.

But as the Latitude by Computation differs considerably from that by Account, the Work must be repeated.

Latitude 48° 57' = 0,18262
Decl. 23 28 = 0,03749

Log. Ratio 0,22011
H. M. S. Diff. N. S. 2430 Its Log. 3,38561
1 50 0 Its Log. 0,33559

0 10 0 Time answering to 3,94131

90 0 1 40 0 Its Log. in Col. of Rising 3,97170
17 37 Log. Ratio 0,22011

Zen. Dist. 72 23 5644 Nat. Num. of 3,75159
Decl. 23 28 24615

Tr. Lat. 48 55 N. 30259 N. S. Mer. Alt. 17° 37'

This Latitude differing only 2 Miles from that used in the Computation, it may be depended upon as the true Latitude.

E X A M P L E VII.

A Ship sailing N. E. half E. by Compass, at the Rate of 9 Knots an Hour, at 0 H. 31 M. 40 S. P. M. per Watch I found the Altitude of the Sun's lower Limb 28° 20' above the Horizon of the Sea, the Eye being elevated 20 Feet above the Surface of the Water, and the Sun's Bearing by Compass being at the same Time S. by W. and at 2 H. 58 M. 20 S. P. M. by Watch, the Altitude of the Sun's lower Limb was 16° 41' above the Horizon, the Eye being elevated as before, and the Latitude by Account, at the Time of the last Observation, was 48° 0' North, and the Declination 13° 17' South. Required the true Latitude at taking the last Observation.

First observed Alt. of S's lower Limb 28° 20' Second ditto 16° 41'
Refraction to be subtracted 2 3

Corrected for Refraction 28 18 16 38
Dip. of the Horizon subtracted 4 4

App. Alt. 28 14 16 34
Sun's Semi-diameter added 0 16 0 16

Correct Altitudes of Sun's Centre 28 30 16 50
Correction

Correction for the first Altitude.

The Time of the first Observation 0 H. 31 M. 40 S. P. M. of the Second 2 H. 58 M. 20 S. P. M. so the Elapsed Time is 2 H. 26 M. 40 S. : the Rate of Sailing is 9 Miles per Hour. Then as 1 H. : 9 Miles :: 2 H. 26 M. 40 S. : 22 Miles, the Distance run in the Elapsed Time.

Again, the Sun's Bearing at the first Observation is S. by W. the opposite Point to which is N. by E. or 1 Point.
The Ship's Course during the Ela. Time is N. E. $\frac{1}{2}$ E. or $4\frac{1}{2}$ Pts.
So the Angle of the Ship's Course with the Sun's Bearing is } N. E. by N. $\frac{1}{2}$ E. $3\frac{1}{2}$ Pts:

In the Table of Difference of Latitude and Departure, to the Course $3\frac{1}{2}$ Points, and Distance 22 Miles, the Difference of Latitude is 17 Miles, while the Ship sails from the Sun.

Wherefore, first observed Altitude $28^{\circ} 30' - 17' = 28^{\circ} 13'$ the first correct Altitude to be used in the Operation.

H. M. S.	Alt.	N. S.	Lat. by Ac.	$48^{\circ} 0'$	0,17449	
Times. 0 31 40	28 13	47281	Decl.	13 17	0,01178	
2 58 20	16 50	28959				
Ela. T. 2 26 40	Diff. N. S.	18322	Log. Ratio		0,18627	
					Its Log.	4,26297
$\frac{1}{2}$ El. T. 1 13 20	Its Log. from Col. of $\frac{1}{2}$ elapsed Time				0,50232	
1 46 30	In Col. of Middle Time correspond. to				4,95156	
0 33 10	Its Log. from Col. of Rising				3,01923	
					Log. Ratio	0,18627
N. S. gr. Alt. 47281						
Mer. Alt. $\frac{90}{28} \frac{0}{40}$	681 N. Num. of				2,83296	
N. S. Mer. Alt. 47962 = $28^{\circ} 40'$						
Zen. Diff. 61 20						
Decl. 13 17						
Lat. 48 3 N.						

And as it differs but three Miles from the Latitude by Account, it may be taken as the true Latitude,

By

By the Ship's Course per Compass is to be understood, its Course made good, Lee-way, if any, being first allowed, or the Course, by Compass, corrected for the Lee-way only, but not for the Variation. Had the Variation of the Compass been applied, both to the Ship's Course and the Sun's Bearing, it would not have made any Difference in the Operation or Result, as the Angle formed by them will always be the same, whether they are both estimated by the Compass, or when the Variation is allowed on both.

This Method of finding the Latitude is of excellent Use, since there are so many Circumstances at Sea, which deny the Opportunity of having the Sun's Meridian Altitude; and as the knowing the true Latitude is of the greatest Consequence, especially in coming into the English Channel, &c. where there are frequent Obstructions of Clouds, every Seaman ought to be ready at determining his Latitude, by this Method, whenever an Opportunity offers, lest he should not see the Sun upon the Meridian.

NOTE. The nearer to Noon the Observations are taken, the better; provided the elapsed Time be not much less than Half the Interval of Time, when they are both taken on the same Side of Noon, nor much greater than Once and Half the greater Interval, when taken on different Sides of Noon.

Of finding the Longitude at Sea.

I HAVE given Rules for correcting the Longitude, as far as can be done, by Help of the Latitude being truly ascertained by Observation.

Notwithstanding, as the Longitude given by dead Reckoning, though kept and corrected with the greatest Care, is very uncertain; therefore it would be of the utmost Importance to Navigation, could it be ascertained exactly, or even within some moderate Limits: Expedients have been proposed for determining it; of these we shall only mention two or three, the Rest having wholly failed.

One Expedient for determining the Longitude at Sea is the Variation Chart, first published by Dr. Halley, in the Year 1700; and since corrected by Mr. Mountaine, F. R. S. which has been found useful on many Occasions, for correcting both the Latitude and Longitude at Sea.

Another

Another Expedient was proposed about 200 Years ago, for shewing the Longitude at Sea, which is an exact Time measurer. Could such a Piece be constructed as to move with perfect Uniformity, at all Seasons and in all Places, such a Time-keeper being set to the Time, at any Place (suppose London) would always shew the precise Time under the Meridian of that Place; then the Time of the Day at any other Place being found, the Difference between this Time and the Time at London, shewed by the Time-measurer, would give the Difference between the Meridian of the Place in, and London; which being converted into Longitude, by allowing 15° for one Hour, &c. would be the Difference of Longitude. The Mariner then would have nothing more to do but to provide himself one of these Time-measurers, regulated to the London Time; and when he thought proper, find the Time of the Day under his then Meridian, and to turn the Difference of Time thus found, and the Time-measurer, corrected by the Equation of Time into Longitude, which would give him his Longitude from London with great Ease and Exactness. But such Irregularities had been found in the Motions of the best Clocks and Watches, especially when exposed to the irregular violent Agitations of a Ship at Sea, and the different Temperatures of Air, and Alterations in the Power of Gravity, attending the Change of Situation and Climate, in long Voyages, that all Attempts made to determine the Longitude by their Means, proved to very little Purpose, till within these few Years: Mr. John Harrison having, by long Application found Means, if not wholly to remove, at least greatly to lessen, many of the Irregularities to which Watches of the common Construction are subject, executed a Watch so much improved, and so exact in its Motion, that in a Voyage made in the Year 1764, by appointment of the Commissioners of Longitude, for a Trial of the Watch, from Portsmouth to Barbadoes, and from thence back to England, which took up about five Months, the Watch was found to have deviated from true mean Time only 54 Seconds: This Watch, however, has not, for some Time past, made any great Noise; and it is difficult to say what Advantage Navigation may reap from it, though it probably may reap some; but certain it is, that whatever Improvements may be made in Clocks and Watches, they, like every mechanical Movement, must ever be subject, probably to some internal constitutional Irregularities, and certainly to Injury, from various Accidents; on which Account the Mariner may, with good Reason, be diffident of them, and anxiously desirous of Means to enable him to find his Longitude, from Time to Time, with sufficient Exactness by celestial Observations.

Of finding the Longitude by celestial Observations.

Many Methods for finding the Longitude by celestial Observation have been proposed and successfully practised on Land ; but none has been found so convenient at Sea, as that of observing the Moon's Distance from the Sun, or a fixed-Star ; both on Account of the Shortness of the Moon's Period, and consequently her quick Progress in her Orbit, and also on Account of her being almost constantly conspicuous, and capable of being observed.

The Moon revolves round her Orbit, or returns to the same Star from which she set out, in 27 Days, 7 Hours, 43 Minutes, and 12 Seconds. She performs her Revolution with Respect to the Sun, or revolves from one Conjunction with him to another, in 29 Days, 12 Hours, 44 Minutes, and three Seconds ; wherefore her daily mean Motion in her Orbit, being little more than 13 Degrees, and her daily mean Motion from the Sun, a little more than 12 Degrees, consequently in 2 Minutes of Time, which answers to Half a Degree of Longitude, she will advance in her Orbit about one Minute, which is a very discernable Alteration of Place.

At Sea, by careful Observation, and a little Calculation, the Moon's Distance may be found from the Sun, or a proper Star ; as also the Time of the Meridian of the Ship when this Distance was observed. From good Lunar Tables, the Time to the Meridian of any noted Observatory, such as Greenwich, may be found ; when her Distance from the Sun, or the aforesaid Star, is the same with that found as above, and the Difference of these Times turned into Longitude, gives the Longitude of the Ship from the Observatory.

About the Beginning of the fifteenth Century, John Warner made some Attempts to render this Method of finding the Longitude at Sea practicable. Dr. Halley judged it the best of all astronomical Methods for this Purpose. But as yet, two Obstacles opposed its yielding any considerable Advantage : The first was, that there was no Instrument by which the Moon's Distance from any other celestial Objects could be observed at Sea, with the necessary Degree of Exactness ; the second, that there were no Lunar Tables that gave the Moon's Place with nearly sufficient Accuracy. Both these Obstacles are now happily removed : the first, by the Invention of John Hadley, Esq. who, about the Year 1730, completed that excellent Quadrant which bears his Name ; and which, accommodated as it now is with Vernier's Division, and other proper Improvements, will, in the Hands of an expert Observer, give an angular Distance of any two remote Objects to a Quarter of a Minute of a Degree. And the other, by the great Diligence and Care of Mr. Tobias Mayer, late Professor of Astronomy at Gottingen, who has brought the Lunar Tables to a Degree of Exactness before unknown. These Tables of Mayer's having, after his Decease, been received in Manuscript

script by the Commissioners of Longitude, and having, by their Order, been carefully compared with Dr. Bradley's Observations, and from thence received some Corrections and Additions, have lately been printed and published, under the Inspection of Dr. Maskelyne, Astronomer Royal; who assures us, that the Error in them scarce ever exceeds 45 Seconds at most, and seldom amounts to 20 Seconds; so that the Uncertainty hence arising in the Determination of the Longitude can scarcely ever amount to half a Degree, and generally will not exceed 10 Minutes. To render Mayer's Tables of general Use, and to save the Mariner the Trouble of Calculation as much as possible, there is now annually published, by Authority of the Commissioners of Longitude, a Nautical Almanack, or Ephemeris, consisting of a Variety of Particulars, useful both to the Navigator and Astronomer; and containing every Thing that can well be done for shortening and facilitating the Operation of finding the Longitude at Sea, by Observations of the Moon's Distance from the Sun or Stars. Every Mariner, desirous of finding his Longitude by Observation, will undoubtedly take Care to provide himself with such Almanacks; which done, he may at any Time compute his Longitude as follows: And, first,

To find the Apparent Time at Sea, and thereby to regulate the going of the Watch.

Among the Methods proposed for this Purpose, that by equal Altitudes seems very fit for Practice at Sea. At the Time when the Watch stands in need of being regulated for the Observations intended, let the Sun's Altitude be taken at any convenient Time in the Forenoon 2, 3, 4, or 5 Hours distant from the Meridian, set down that Altitude and corresponding Time exactly, (the Index of the Quadrant being already set to the Morning Altitude) note down the Time of the same Altitude in the Afternoon; then Half the Sum of these two Times is the apparent Time shewn by the Clock or Watch, when the Sun was upon the Meridian of that Place.

Lest that an Altitude taken in the Forenoon cannot, by the Interposition of Clouds, have a corresponding one in the Afternoon, it is therefore proper to take several in the Forenoon, in order to have a greater Probability of securing a corresponding one in the Afternoon; and if several Observations of equal Altitudes can be taken on both Sides of the Meridian, it will be best to find the Noon for each Pair, and take the Mean of all the Noons thus found for the true one.

If there is Reason to believe that the Watch gains or loses considerably in a Day, other Sets of Observation should be taken on successive Days, whereby the daily Variation of the Watch may be found and allowed for; by which Means the Artist will have little more to do, in finding his Longitude by Observation, than to reduce the observed Distance to the true Distance of their Centres; the Ship's Time being shewn by the Watch previously regulated.

O F F I N D I N G T H E

E X A M P L E.

May 20, 1786, at 8 H. 40 M. Forenoon, and at 3 H. 16 M. Afternoon, by a Watch, the Sun had equal Altitudes. Required the Going of the Watch?

H. M.
Now add together
12 0
8 40
3 16

Take Half the Sum 23 56

Gives Noon per Watch 11 58
True Noon 12 0

Watch too slow 2

March 18, 1786, being in Lat. 49° N. at 8 H. 10 M. 58 S. Forenoon, and at 3 H. 58 M. 34 S. I had equal Altitudes of the Sun. How did the Watch go?

H. M. S.
Add together
12 0 0
8 10 58
3 58 34

Take Half the Sum 24 9 32

Gives Noon per Watch 12 4 46
True Noon 12 0 0

Watch too fast 4 46

To find the apparent Time at Sea, by an Altitude of the Sun or a Star.

With a good Hadley's Quadrant, well adjusted, take the Altitude of the Sun's lower Limb; take the Difference between the Sun's Semi-diameter, found in Page 3 of the Month in the Ephemeris, and the Dip of the Horizon, and add it to the observed Altitude of his lower Limb, and you will have the apparent Altitude of his Centre.

From which subtract the Correction of his Altitude, as found in the first Table, and the Remainder will be the true Altitude of his Centre; hence you have his true Zenith Distance.

Find the Ship's Latitude and Longitude by Account, at the Time of Observation, by carrying the Reckoning forward to that Time.

Find also the Sun's Declination in Page 2 of the Month in the Ephemeris, and correct it by the Ship's estimated Longitude, and the Time of the Observation from Noon; with this corrected Declination find the Polar Distance, by adding to it 90°, when the Latitude and Declination are one North, and the other South, but if both are North or South, subtracting the Declination from 90°, gives the Sun's Distance from the elevated Pole. Then,

Add together the Ship's Co. Latitude, the Polar Distance, and the Zenith Distance.

From Half their Sum subtract the Zenith Distance, noting the said Half Sum, and also the Difference.

Then to the arithmetical Comp. of the Co-Sine of the Latitude, add the arithmetical Co-sine of the Polar Distance, and the Logarithm Sines of the Half Sum and the Difference.

Half the Sum of these four Logarithms is the Co-sine of Half the Horary Angle; which, being doubled, gives the Horary Angle, or Distance of the Sun from the Meridian.

The Angle turned into Time, by allowing one Hour to every fifteen Degrees, &c. will give the apparent Time at the Ship, if it be in the

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the Afternoon; but if it be in the Forenoon, the Complement to 24 Hours, will give the apparent Time, counted from the preceding Noon.

E X A M P L E I.

Suppose a Ship at Sea, in Lat. $39^{\circ} 54' N.$ and Long. $35^{\circ} 30' W.$ of Greenwich, by Account, on the 7th of May 1786, at 5 H. 30 M. P. M. by Watch, the Altitude of the Sun's lower Limb was found by Observation to be $15^{\circ} 45'$, the Eye being 18 Feet above the Water. What was the true apparent Time when the Observation was taken?

Ob. Alt. S's low. Limb	$15^{\circ} 45' 0''$	Ship's Lat.	$39^{\circ} 54'$
Semi-di.	$15' 53''$	Co. Lat.	$50^{\circ} 6'$
Dip.	4 3		H. M.
Diff. Semi-di. and Dip.	11 50	Ti. at Ship per Watch	5 30
		Long. p. Ac. $35^{\circ} 30'$	= 2 22
App. Alt. Sun's Centre	$15^{\circ} 56' 50''$		
Correction from Table I.	3 8	Ap. Ti. at Green. p. W.	7 52
Sun's true Alt.	$15^{\circ} 53' 42''$		
Sun's true Zen. Dist.	$74^{\circ} 6' 18''$		

The Sun's Declination, May 7, at Noon, by the Ephemeris, is $16^{\circ} 56' 10'' N.$ May 8, it is $17^{\circ} 12' 28'' N.$ the daily Diff. or Increase is $16' 18''$.

Then, as $24 : 16' 18'' :: 7 H. 52 M. : 5' 20''$, which added to $16^{\circ} 56' 10''$, the Sun's Declination the preceding Noon, gives $17^{\circ} 1' 30''$ the Sun's true Declination at the Time and Place of Observation, which being subtracted from 90° , leaves $72^{\circ} 58' 30'' N.$ the Polar Distance.

Ze. Dist.	$74^{\circ} 6' 18''$		
Co. Lat.	$50^{\circ} 6' 0''$	Ari. Co Sine	0.11511
Pol. Dist.	$72^{\circ} 58' 30''$	Ari. Co-Sine	0.01946
Sum	$197^{\circ} 10' 48''$		
Half Sum	$98^{\circ} 35' 24''$	Log. Sine	9.99510
Sub. Zen. Dist.	$74^{\circ} 6' 18''$		
Diff.	$24^{\circ} 29' 6''$	Log. Sine	9.61748
Half Sum of 4 Logs.			19.74715
Half Hour Ang. $41^{\circ} 37' 54''$		Co-fi. $\frac{1}{2}$ Sum	9.87357

Hour Angle $83^{\circ} 15' 48''$
 which divided by 15, gives 5 H. 33 M. 3 S. the true Time when the Observation was taken; so the Watch was 3 M. 3 S. too slow.

NOTE. The Logarithm for Seconds is found by taking the Difference of the Logarithms for 1 Minute more, and 1 Minute less than the Degrees, Minutes, and Seconds required; then say, as 60 Minutes is to that Difference, so is the given Seconds to a fourth Number, which being added to, or subtracted from the nearest preceding Logarithm, according as they are increasing or decreasing, gives the Logarithm sought.

Suppose the Logarithm Sine for 72 Degrees 58 Minutes, 30 Seconds were required?

Log. Sine of 72° 58' is 9,98052	} Log. Sine 72° 58' 30''	10,00000
Log. Sine of 72 59 is 9,98056		9,98054
Difference ——— 4		
		Ari. Co. Sine 0,01946

Then as 60'' : 4 :: 30'' : 2 which added to } The same of any Num.
9,98052 gives 9,98054 the Log. required. } of Deg. Min. and Sec.

By reverfing the above you will find the Degrees, Minutes, and Seconds, corresponding to any given Logarithm.

Suppose the Logarithm 9,87357 was given to find the Degrees, Minutes, and Seconds answering to it in the Column of Co. Sines; the Logarithms nearest to this are found under Co. Sine 41° 37' and 41° 38' viz. 9,87367—9,87356 their Difference is 11, and the Difference between the first Logarithm and the given one is 10; now, as 11 : 60'' :: 10 : 54'' which being added to 41° 37' gives 41° 37' 54'', the Degrees, Minutes, and Seconds required.

In like Manner the Logarithm for any given Number of Degrees, Minutes and Seconds, may be found, and the contrary.

But if the Seconds be any even Part of a Minute, the like Parts of the Difference of the Logarithms may be taken, and either added to, or subtracted from the next greater or less Logarithm, according as they are increasing or decreasing.

Thus 5'' is $\frac{1}{12}$, 10'' = $\frac{1}{6}$, 15'' = $\frac{1}{4}$, 20'' = $\frac{1}{3}$, 30'' = $\frac{1}{2}$, 40'' = $\frac{2}{3}$, 45'' = $\frac{3}{4}$, 50'' = $\frac{5}{6}$, &c. hence, by taking equal Parts, the Calculation will be greatly shortened, wherever a Proportion is necessary.

E X A M P L E. II.

Suppose on the 10th of October, 1786, in Lat. 51° 30' N. and Long. 52° East, the Altitude of the Sun's lower Limb was found as under, the Eye being elevated 22 Feet above the Surface of the Sea; required the true Time of the Day, the Times per Watch were as under?

Times.	Altitudes.	H. M.
H. M.		Time at Ship per Watch 20 21
8 14	12° 28'	Ship's Long. E. in Time 3 28 Sub.
8 19	13° 20'	
8 30	14° 51'	Supposed Ti. at Green. 16 53
3) 25 3	3) 40 39	Ship's Lat. per Acc. 51° 30' N.
		Ditto Co. Lat. 38 30
Means 8 21	13 33	

Obs.

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Obs. Alt. of S's low. Limb.	13° 33' 00"	S's Decl. 9th Oct.	6° 25' 51"
Dip of Hor. for 22 F.	4' 28"	Ditto 10th	6 48 38
S's Semi-di. that Day	16 5		
	0 11 37	Daily Diff. of Dec.	22 47
	13 44 37	H. ' ' h. m.	
Correct. from Tab. I. sub.	3 41	As 24: 2247 :: 16 53: 16 2	
Sun's true Alt. of Centre	13 40 56	S's. Dec. 9th at N.	6 25 51'
	90°	S's. true Dec at Ship	6 41 53
			90°
Sun's Zenith Distance	76 19 4	Polar Distance	96 41 53
Add { Polar Distance	96 41 53	—	0,00298
Co-Latitude	38 30 00	—	0,20585
Sum	211 30 57		
Half Sum	105 45 28	—	9,98336
Subtract Zenith Distance	76 19 4		
Remainder	29 26 24	—	9,69153
		$\frac{1}{2}$)	19,88372
			28° 59' 26"
			9,94186
			2 H. M. S.
Hour Angle	57 58 52	=	3 51 55

which being subtracted from 24 Hours, leaves 20 H. 8 M. 5 S. the true Time past Noon, Oct. 9th; or 8 H. 8 M. 5 S. A. M. Oct. 10th. So the Watch is fast 12 M. 55 S.

To find the apparent Time at Sea by an Observation of a Star.

Having carefully observed the Star's apparent Altitude, and corrected it by the Dip and Refraction, find the Ship's Latitude and Longitude by Account, at the Time of Observation, by carrying the Reckoning forward to that Time; and then find the Star's right Ascension and Declination.

From the Ship's Lat. and the Star's correct Declination and Altitude, find the Co. Lat. Polar Distance, and Zenith Distance, and with these find the Hour Angle (as shewn in the Examples of the Sun) turn the Hour Angle into Time, and apply it to the Star's right Ascension, by subtracting it when the Star is East of the Meridian, and adding it when it is West; this will give the right Ascension of the Mid. Heaven.

From the Ascension of the Mid. Heaven (increased by 24 Hours if necessary) subtract the Sun's right Ascension at the preceding Noon

at Greenwich, taken from Page 2 of the Month in the Ephemeris, the Remainder is nearly the apparent Time of the Observation at the Ship; to which apply the Longitude of the Ship from Greenwich, turned into Time, adding it when the Longitude is West of Greenwich, and subtracting it when East, and you will have the apparent Time of the Observation nearly, by the Meridian of Greenwich.

Then say, as 24 Hours is to the daily Variation of the Sun's right Ascension, so is this Time to a Number of Minutes and Seconds, which subtract from the Time of Observation at the Ship, found as above, leaves the correct apparent Time at the Ship. Note. As the Right Ascension and Declination of the Stars are set down for 1779, they must be reduced to the present Year by Addition or Subtraction.

NOTE. Though the Method of finding the Time by a Star be true in Theory, yet I would advise the Observer to regulate his Watch by the Sun, as the Time found by a Star may be erroneous, for want of a good Horizon in the Night.

E X A M P L E.

Suppose at Sea, May 18, 1786, P. M. in Latitude $33^{\circ} 43' N$. and Longitude $45^{\circ} 0'$ West of Greenwich by Account, the Altitude of the bright Star in the Harp Lyra, when East of the Meridian, was observed to be $36^{\circ} 3'$, the Height of the Eye above the Sea being 16 Feet. Required the apparent Time of Observation?

Altitude	$36^{\circ} 3' 0''$	Ship's Lat.	$33^{\circ} 43' N$.
Dip. for 16 Feet $3' 49''$		Co. Lat.	$56 17$
Refraction $1 18$	$5 7$	Lyra Decl.	$38 35 27$
		Polar Distance	$51 24 33$
True Alt. of Lyra	$35 57 53$		
Zen. Dist.	$54 2 7$		

Whence to find the Time.

Zen. Dist.	$54^{\circ} 2' 7''$		
Co. Lat.	$56 17 0$	Ari. Co. Sine	0,07998
Polar Dist.	$51 24 33$	Ari. Co. Sine	0,10701
Sum	$161 43 40$		
Half Sum	$80 51 50$	Log. Sine	9,99446
Sub. Zen. Dist.	$54 2 7$		
Difference	$26 49 43$	Log. Sine	9,65449
		Sum 4 Logs	$19,83594$
Log. Co. Sine half Hour Ang.			$9 91797 = 34^{\circ} 7' 6''$
			2
The Hour Angle			$68 14 12$
In Time by Table 5th			$4h. 32' 57''$

	H. M. S.
Which subtracted from Lyra's right Ascension	4 32 56 18 29 41
The Rem. is the right Ascension of the Mid. Heaven	13 56 45
From which sub. the Sun's right Ascen. May 18, at Noon	3 41 19
Remains the apparent Time of the Ship nearly	10 15 26
Add Ship's Longitude West of Greenwich	45° = 3 0 0
Sum is apparent Time at Greenwich nearly	13 15 26
Sun's Right Ascension, May 18, at Noon is	3 41 19
Ditto May 19,	3 45 18
Daily Diff. or Increase of right Ascension	3 59

Then say, as 24 H. : 3' 59" :: 13 H. 15 M. 26 S. : 2' 12", which subtracted from 10 H. 15 M. 26 S. the Time at the Ship, leaves 10 H. 13 M. 14 S. the correct apparent Time at the Ship, when the Observation was taken.

Q U E S T I O N I.

Suppose that on the 4th of April, 1786, the Altitude of the Sun's lower Limb was observed $47^{\circ} 13'$, the Eye being 18 Feet above the Surface of the Sea; at the same Time the Latitude corrected for the Ship's Run since the preceding Noon being $16^{\circ} 24' N$, the Longitude by Account $43^{\circ} 37' W$. of Greenwich, and the Time at the Ship 2h. 41m. per Watch. Required the true Time at the Ship?

Answ. True Time at the Ship is 2h. 48' 49", Watch slow 7' 49".

Quest. II. Suppose on the 7th of September, 1786, in Lat. $7^{\circ} 45' S$. Long. $30^{\circ} 18'$ East of Greenwich, the Altitude of the Star Procyon, being then E. of the Meridian, was $28^{\circ} 16'$, and the Eye 18 Feet above the Surface of the Sea. Required the true Time?

Answ. 16h. 17' 44" P. M.

NOTE. 1. If an Observation of the Sun has not been taken the preceding Noon, or two Altitudes to find the Latitude, it may be ascertained by taking the Meridian Altitude of the Star, either before or after the Observation is made for finding the Time.

NOTE 2. If the Ship's Longitude East of Greenwich in Time be greater than the apparent Time at the Ship, the apparent Time must be increased by 24 Hours before the Longitude is subtracted; and in this Case, the Sun's right Ascension must be taken out of the Ephemeris for one Day of the Month less than that by the Ship's reckoning. And if the Ship's Longitude W. of Greenwich in Time, when added to the apparent Time of the Ship, makes more than 24 Hours, 24 H. must be subtracted from the Sum, to obtain the apparent Time

Time at Greenwich ; and in this Case, the Sun's Right Ascension must be taken out of the Ephemeris for one Day of the Month more than that by the Ship's Reckoning.

The Object, whether Sun or Star, whose Altitude is taken for finding the Time, must be, at least, three or four Points of the Compass distant from the Meridian ; because near the Meridian, the Alteration in Altitude is too slow for ascertaining the Time with proper Exactness ; but the nearer the Object is to the East or West the better, provided it be not less than 6° high ; for as the Refraction is not only considerable, but irregular near the Horizon, less Altitudes than 6° ought not to be used, as the Effect of Refraction upon them cannot be determined with sufficient Certainty.

As often as the Moon's Distance from the Sun or Star is observed, in order to find the Longitude, the apparent Time at the Ship must be found. The Difference between this Time and the Time of taking the Altitude for finding it, given by the Watch, shews the Error of the Watch, whether it be too fast or too slow ; and this Error must be carefully allowed for, in estimating the Time of taking the Moon's Distance from the Sun or Star. The less the Interval of Time, between the Altitude for the apparent Time, and the observing of the Moon's Distance, the better ; and it will be immaterial whether it be taken before or after the Observation of the Distance.

To take the Observations necessary for finding the Longitude at Sea.

The capital Observation for this Purpose is, that of the Distance of the Moon from the Sun, or some remarkable Star, not far from the Zodiac. In order to make such Observations, the Observer must be furnished with a Watch that can be depended upon for keeping Time, within a Minute, for six Hours ; and with a good Hadley's Quadrant, or rather Sextant, which is preferable to a Quadrant. The Instrument will still be more fit for the Purpose if it be furnished with a Screw, to move the Index gradually and steadily ; an additional dark Glass, lighter than the common Screens, to take off the Glare of the Moon's Light, in observing her Distance from a fixed Star ; and a small Telescope, magnifying three or four Times, to render the Contact of the Star with the Moon's Limb more discernable ; a magnifying Glass of $1\frac{1}{2}$ or 2 Inches Focus will assist the Observer to read of his Observations with greater Ease and Certainty.

The Observer must, in the first Place, examine his Instrument with the greatest Care, and adjust it with the utmost Exactness ; which done, let him proceed to his Observations as follows :

If the Distance of the Moon from the Sun is to be observed, turn down one of the Screens, look at the Moon directly through the transparent Part of the Horizon-glass, and, keeping her there, gently move

move the Index till the Sun's Image is brought into the silvered Part of that Glass, bring the nearest Limbs of both Objects into contact, and let the Quadrant librate a little on the Lunar Ray, whereby the Sun will appear to rise and fall by the Side of the Moon; in this Motion the nearest Limbs must be made to touch one another exactly, by moving the Index; when this is effected, the Observation is made; and the Division coinciding with that on the Vernier Scale, will shew the Distance of the nearest Limbs of the Objects.

If the Distance of the Moon from a Star is to be observed, when the Moon is very bright, turn down the lightest Screen, or use a dark Glass, lighter than the Screens, and designed for this particular Purpose; look at the Star directly through the transparent Part of the Horizon-glass, and, keeping it there, move the Index till the Moon's Image is brought into the silvered Part of the same Glass; make the Quadrant librate gently on the Star's Ray, and the Moon will appear to rise and fall by the Star; move the Index, between the Librations, until the Moon's enlightened Limb is exactly touched by the Star, then the Observation is properly made.

The Quadrant is to be held the same as for a fore Observation, and its Plane must always be made to pass through the two Objects, whose Distance is to be observed; for that Purpose it must be put into various Positions, according to the Situation of the Objects, which will soon be rendered easy by Practice.

At the very Instant, or at most within a few Seconds of the Time at which the Observer gives Notice of completing his Observation, somebody must observe the Hour, Minute, and Quarter Minute (if there be no Second Hand) by the Watch, used for finding the apparent Time, and at the same Instant of the Observer's giving the aforesaid Notice, or as near to that Time as possible, two Assistants must take the Altitudes of those Objects, whose Distance is observed; all which being done, the Observations necessary for ascertaining the Longitude are completed.

In the Ephemeris is found, the Moon's Distance from the Sun, and also from proper Stars, to every Three Hours of apparent Time, by the Meridian of Greenwich; and to afford the Mariner a greater Number of Opportunities for Observing, and Means of attaining a greater Degree of Exactness, her Distance is generally set down from at least one Object on each Side of her. Her Distance from the Sun is found set down, while it is between 40° and 120° , so that by using a Sextant, it may be observed for two or three Days after her first, and before her last Quarter; while she is between 20° and 40° from the Sun, her Distance is set down only from a Star on the contrary Side to the Sun; while she is between 40° and 90° from the Sun, her Distance is set down both from the Sun and from a Star on the contrary Side to the Sun; when she is between 90° and 120° from the Sun, her Distance is set down both from the Sun and a Star, on the same Side with the Sun, and also from a Star on the contrary Side to the Sun. Lastly, when she is above 120° from the Sun, her Distance is set down from two Star's, one on each Side of her. Her Distance

from Objects on the East of her is found in the Ephemeris, in the 8th or 9th Pages of the Month; and her Distance from Objects on the West of her is found in the 10th and 11th Pages of the Month.

An Observer who uses the Ephemeris, must observe the Moon's Distance from some of those Stars only, whose Distance from her is set down in the Ephemeris, and the Distances there set down afford him a ready Means of knowing the Star from which her Distance ought to be observed; for he has nothing to do but to set his Index to the Distance computed roughly at the apparent Time, estimated nearly for the Meridian of Greenwich, and look to the East or West of the Moon, according as the Distance of that Star is found in the 8th or 9th, or in the 10th or 11th Pages of the Month, and having found the Moon upon the Horizon Glass, he will by Sweeping with his Quadrant to the Right or Left, certainly find the Star he wants, if it be above the Horizon and the Air clear, in a line nearly perpendicular to that joining the Moon's Horns, or, which is the same, in the Line of the Moon's shortest Axis produced.

The Time at Greenwich is estimated nearly by turning the Ship's supposed Longitude from Greenwich into Time, and adding it to, or subtracting it from the apparent Time at the Ship, according as the Ship is East or West of Greenwich, and the Distance of the Moon from the Sun or a Star at this Time is found roughly by saying as 180' (the Minutes in 3 Hours) is to the Difference in Minutes, between this nearly estimated Time and the next preceding Time set down in the Ephemeris, so is the Difference in Minutes between the Distances in the Ephemeris for the next preceding and next following Times, to a Number of Minutes, which being added to, or subtracted from the said next preceding Dist. according as it is increasing or decreasing, will give the Dist. nearly at the Time the Observation is intended to be made, and to which the Index of the Quadrant or Sextant must be set.

To find the apparent Altitudes and Distances of the Sun and Moon, or of the Moon and Stars.

First, To the Apparent Time of the Observation at the Ship apply the Longitude turned into Time, by Subtraction or Addition, according as the Ship is East or West of Greenwich, this will give the apparent Time of the Observation, which call the reduced Time.

Secondly, In Page 7th of the Month in the Ephemeris, seek the nearest Noon or Midnight preceding the reduced Time; and also the nearest Noon or Midnight following it, always taking the nearest to the reduced time, both before or after it, whether it be Noon or Midnight.

Thirdly, Write down the Moon's Semi-diameter and horizontal Parallax for the preceding Noon or Midnight, also for the following Noon or Midnight, and find the Difference between the two Semi-diameters, and between the two Horizontal Parallaxes; the first

of these Differences is the Variation of the Semi-diameter in 12 Hours, and the second is the Variation of the horizontal Parallax in 12 Hours. Then say, as 12 Hours is to the Variation of the Semi-diameter in 12 Hs. so is the Difference between the reduced Time and the next preceding Noon or Midnight, to a fourth Proportional; and, in like Manner, so is the Variation of the Horizontal Parallax, to a fourth Proportional. These fourths applied respectively to the Semi-diameter and the Parallax for the preceding Noon or Midnight, by Addition or Subtraction, according as the Semi-diameter and the Parallax are increasing or decreasing, give the Moon's horizontal Semi-diameter and Parallax for the reduced Time.

Fourthly. To the Moon's horizontal Semi-diameter for reduced Time, add the Correction answering to her observed Altitude taken from Table II. the Sum is the apparent Semi-diameter at the Time and Place of Observation.

Fifthly. To the observed Distance of the Moon's Limb from a Star apply the Moon's true apparent Semi-diameter, just found by Addition or Subtraction, according as the Limb nearest to, or farthest from the Star, was observed, and you will have the apparent Distance of the Moon's Centre from the Star; but to the observed Distance of the Sun and Moon's nearest Limb, add the Sum of the Sun's Semi-diameter, taken from Page 3 of the Month in the Ephemeris, and the Moon's true apparent Semi-diameter just found, and you will have the apparent Distance of their Centres.

Sixthly. Take the Difference between the Sun's Semi-diameter found in the Ephemeris and the Dip of the Horizon, and add it to the observed Altitude of the Sun's lower Limb; or subtract it from the observed Altitude of his higher Limb, and you will have the apparent Altitude of his Centre.

Seventhly. Take the Difference between the Moon's true apparent Semi-diameter and the Dip, and add it to the observed Altitude of her lower Limb; or subtract it from the observed Altitude of her higher Limb, and you will have the apparent Altitude of her Centre; and subtract the Dip from the observed Altitude of a Star, and you will have its apparent Altitude.

Having the apparent Altitude of the Objects, with their apparent Distance, to find their true Distance; and thereby to determine the Longitude.

From the apparent Altitude of the Sun's Centre subtract the Correction for that Altitude, taken from Table I. or if a Star, its Refraction, and you will have their true Altitudes.

To the apparent Altitude of the Moon's Centre add the Correction in Table III, answering to that Altitude and the Horizontal Parallax at the reduced Time, and you will have the true Altitude.

Whence to find the Distance.

RULE. With the Moon's apparent Altitude and Horizontal Parallax for reduced Time, take the Logarithm from Table IV. which reserve.

Secondly, To the apparent Distance of the Moon from the Sun or Star add the Difference of their apparent Altitudes, and take half the Sum; then subtract the Difference of the apparent Altitudes from the apparent Distance, and take half the Remainder.

Thirdly, add the Logarithm Sine of the above half Sum, the Logarithm Sine of the above half Difference, and the Logarithm served, together; reject 10 from the Index, and half the remaining Sum will be the Logarithm Sine of an Angle; to this Angle add, and also subtract from it, the Difference of the true Altitudes. Then add the Logarithm Co-sine of the Sum to the Logarithm Co-sine of the Difference, and half the Sum of these two Logarithms will give the Logarithm Co-sine of half the true Distance required.

In the Ephemeris, among the Distances of the Objects on the Day of Observation, seek for this computed Distance, and if it be there, the Time at Greenwich, when the Distance was taken, will be found above it at the Top of the Column; but if the computed Distance falls between two Distances in the Ephemeris, as it generally will; then say, as the Difference between the two nearest Distances is to 3 Hours, the corresponding Time, so is the Difference between the first of these Distances and the computed Distance, to the Time corresponding to that Difference; which being added to the Time standing over the said first Distance in the Ephemeris, gives the true Time at Greenwich, when the Distance of the Objects were taken. The Difference between this Time and the Time of the Observation at the Ship, being turned into Longitude by Table V. will give the Ship's Longitude from Greenwich, E. or W. according as the Time at the Ship is greater or less, than that of Greenwich.

EXAMPLE

EXAMPLE I.

Being at Sea May the 15th, 1786, in Latitude $33^{\circ} 43' N.$ and Longitude by Account $10^{\circ} 46' E.$ of Greenwich, at 10 H. 14 M. 53 S. per Watch, well regulated by the bright Star in the Harp Lyra, I observed the Distance of the Moon's farthest Limb from the Star Spica to be $63^{\circ} 50' 20''$, at the same Time the Altitude of the Moon's lower Limb was $24^{\circ} 18' 40''$, and the Altitude of the Star Spica, $45^{\circ} 13' 15''$; these Observations were made with Hadley's Quadrant well adjusted, the Height of the Eye above the Water being 18 Feet. Required the Ship's true Longitude?

	H. M. S.
Apparent Time at the Ship	10 14 53
Longitude by Account $10^{\circ} 46' E.$ turned into Time	43 04
Reduced or supposed Time at Greenwich	9 31 49

By the Ephemeris for May, Page the 7th:

Moon's Semi-diameter May 15th at Noon	14' 58"	Horizontal Par. at Noon	54 57"
Ditto at Midnight	15 02	Ditto at Midnight	55 09
Difference or Increase in 12-Hours	04	Diff. or Increase in 12 H.	12

H. M.	H. M. S.	' "	H.	"	H. M. S.	' "
Then, As 12 : 4 :: 9 31 49 : 0 3			And as 12 : 12 :: 9 31 49 : 0 10			
Semi-diameter at Noon		14 58	Horizontal Parallax at Noon		54 57	
Semi-diameter at reduced Time		15 01	Ditto at reduced Time		55 7	
Correction for Moon's obs. Alt. from Table II.		7	Observed Altitude of Moon's lower Limb		24 18 40"	
True apparent Semi-diameter		15 08	Difference of Semi-diameter and Dip $15' 8'' - 4' 3''$		11 5	
Obs. Dist. of Moon's farthest Limb from Spica		63 50 20	Moon's apparent Altitude		24 29 45	
Apparent Dist. of Centres		63 35 12	Correction from Table III.		48 07	
Star's observed Altitude		45 13 15"	Moon's apparent Altitude		25 17 52	
Dip for 18 Feet (Page 159)		4 3				
Star's apparent Altitude		45 9 12				
Refraction		57				
Star's true Altitude		45 8 15				

Note. To find the reserved Logarithm, look in Table 4th for the Moon's Apparent Altitude at the Top of the Page, and the Horizontal Parallax in the left Hand Column, and in the Angle of meeting, stands the reserved Logarithm.

The same Method is to be observed in finding the Corrections in Table III.

When there are Minutes in the Apparent Altitude, take the Correction for the Degrees, and the Difference between it and the next higher Degree of Altitude, and then say, as 60 Minutes is to the whole Difference, so are the given Minutes to their proportional Part; which being added to, or subtracted from the first Correction, according as it is increasing or decreasing, will give the required Correction. In like Manner may the reserved Logarithm be found.

To

OF FINDING THE

To find the Distance.

Reserved Log. 9,99730

Moon's apparent Altitude	24° 29' 45"	Moon's true Altitude	25° 17' 52"
Star's Ditto	45 09 12	Star's Ditto	45 08 15
Difference of apparent Altitudes	20 39 27	Difference of true Altitudes	2) 19 50 23
Apparent Distance	63 35 12	Half Difference	9 55 11
Sum	2) 84 14 39		
Half Sum	42 07 19	Log. Sine of the Half Sum	9,82653
Difference	2) 42 55 45		
Half Difference	21 27 52	Log. Sine of the Half Difference	9,56339
		Reserved Logarithm	9,99730
		Sum, 10 from the Index rejected	2) 19,38723
Angle	29° 35' 42" =	To the Log. Sine of the Half Sum	9,69361
Half the Diff. of true Alt.	9 55 11		
Sum	39 30 53		
Difference	194° 31	Log. Co-sine	9,88731
		Log. Co-sine	9,97388
		Sum	2) 19,86119
Half the true Distance	31° 32' 15" =	Log. Co-sine $\frac{1}{2}$ Sum	9,93059
	2		
True Distance	63 04 30		

By the Ephemeris for May 15th, 1786.

Next preceding Distance at 9 H.	62° 47' 11"	Ditto	62° 47' 11"
Following Distance at 12	64 19 01	True Distance	63 04 30
Difference in 3 Hours	1 31 50	Computed Difference	17 19

As 1° 31' 50" : 3 H. :: 0° 17' 19" :	H. M. S.	
Time over next preceding Distance	0 33 57	
	9 00 00	
Time at Greenwich	9 33 57	
Time at the Ship	10 14 53	D. M. S.
True Time	40 56 = 10 14 0	Longitude in E.

The Longitude is East, because the Time at the Ship is greater than the Time at Greenwich; had it been less, the Longitude would have been West.

EXAMPLE

E X A M P L E II.

Being at Sea November the 11th, 1786, in Longitude by Account 4° West of Greenwich, at 6 H. 10 M. P. M. per Watch well regulated, I observed the Distance of the Sun and Moon's nearest Limbs to be $102^{\circ} 57' 30''$, the Altitude of the Sun's lower Limb being $18^{\circ} 47' 30''$, and that of the Moon $70^{\circ} 32'$, the Eye elevated 20 Feet above the Water. Required the true Longitude?

	H. M.		
Apparent Time at the Ship	6 10		
Long. by Acc. 4° W. reduced to Time	0 16	Which add, because it is West.	
Reduced Time at Greenwich	6 26		
Moon's Semi-diameter, Nov. 11th at Noon	15' 52"	Hor. Parallax at Noon	53' 15"
Ditto at Midnight	15 44	Ditto at Midnight	57 46
Difference of Semi-diameter in 12 Hours	08	Diff. of Parallax in 12 H.	29
Then, as 12 H. : 8" :: 6 H. 26 M. = $0^{\circ} 04'$		And as 12 H. : 29" :: 6 H. 26 M. = $0^{\circ} 15'$	
Semi-diameter at Noon	15 52	Horizontal Parallax at Noon	53 15
Apparent Semi-diameter	15 48	Ditto at reduced Time	58 00
Correction from Table II.	0 15		
Moon's true apparent Semi-diam.	16 03	Moon's true apparent Semi-diam.	16 03
Sun's Ditto	16 13	Dip for 20 Feet	4 16
Sum	32 16	Difference	11 47
Obs. Dist. of Sun & Mn's Limbs	102 57 30	Moon's observed Altitude	70 32 00
Apparent Distance	103 29 46	Apparent Alt. of Moon's Cen.	70 43 47
		Correction from Table III.	18 48
Sun's Semi-diameter	16 13	True Alt. of the Moon's Centre	71 02 35
Dip for 23 Feet	4 16		
Difference	11 57		
Sun's observed Altitude	18 47 30		
Sun's apparent Altitude	18 59 27		
Correction from Table I.	2 35		
Sun's true Altitude	18 56 52	Reserved Log. 9,99326	

To find the Distance.

Moon's apparent Altitude	70° 43' 47"	Moon's true Altitude	71° 02' 35"
Sun's Ditto	18 59 27	Sun's Ditto	18 56 52
Diff. of apparent Altitudes	51 44 20	Diff. of the true Altitudes	52 05 43
Apparent Distance	103 29 46	Half Difference	26 02 51
Sum	155 14 06		
Difference	51 45 26		
Half Sum	77 37 03	Reserved Log.	9,99326
Half Difference	25 52 43	Log. Sine	9,98978
		Log. Sine	0,62094
Angle	40 22 52	Sum, 10 from the Index rejected	1,02298
		To Log-Sine of the Half Sum	9,81149

Angle	40	22	52		
Half Diff. of the true Altitudes	26	02	51		
Sum	66	25	43	Log. Co-sine	9,60195
Difference	14	20	01	Log. Co-sine	9,98627
				Sum	19,58822
Half the true Distance	51	30	15	Log. Co-sine of half Sum	9,79411
True or computed Distance	103	00	30		
Preceding nearest Distance at 6 Hours	103°	15'	10"	Ditto	103° 15' 10"
Following nearest Distance at 9 Hours	101	42	17	Computed Dist.	103 00 30
	1	32	53		14 40
As 1° 32' 53" : 3 H. :: 14' 40" : oh 28' 25"					
Time standing over preceding Dist.	6	00	00		
Time at Greenwich	6	28	25		
Time at the Ship	6	10	00		

0 18 25 = 4° 36' $\frac{1}{4}$ Longitude in W. because the Time at the Ship is less than the Time at Greenwich.

Note. The taking of the Angular Distance may be rendered more easy and accurate by bringing the Objects nearly into contact in the common Way, and then fixing the Index tight to a certain Degree and Minute, and waiting until the Objects are nearly in contact, giving Notice to the Assistants to get ready with the Altitudes, and when the Objects are exactly in contact, to call for the Altitudes and the precise Time by the Watch. The Observer may then prepare for taking another Distance, by setting his Index three or four Minutes forwards or backwards, according as the Objects are receding from, or approaching to each other; and then proceed to take the Distance, the Altitudes, and the Time by the Watch, as before; thus may as many Distances be taken as the Observer thinks proper; but four, at the Distance of three Minutes, or three, at the Distance of four Minutes upon the Instrument, will at all Times be sufficient. This Mode of taking the Distance will not only ease the Eye of the Observer, but also enable him to manage his Instrument with much greater Facility in every Direction, a vertical one only excepted. If, in taking the Distances, the middle one can be taken at any even Division on the Arch, such as a Degree, or a Degree 20 or 40 Minutes, that Distance will be independent of the Nonius Division, and consequently free of those Errors which frequently arise from the Inequality of that Division in several Parts of the graduated Arch. If the Observation be made, as it always ought to be, at the Distance of two Hours before or after Noon, the true Time may be found by the Altitude of the Sun taken at the precise Time of the Distance; if three Distances are taken, find the Time by the Altitude corresponding with the middle Distance. Thus will any Irregularity in the going of the Watch be prevented from affecting the Result of the Observation.

As the Time found by the Altitude of a Star cannot be depended on, because of the Uncertainty of the Horizon in the Night, the best Way of determining the Time for a Night Observation will be by two Altitudes of the Sun, one taken on the preceding Afternoon, before he is within six Degrees of the Horizon, and the other on the next Morning, when he is more than six Degrees high. The proper Use of the foregoing Directions will greatly depend on the Atmosphere's being pretty free from Clouds at the Time of taking the several Distances, for otherwise the Observer must take the Distances at such Times as he can best obtain them.

EXAMPLE

LONGITUDE AT SEA.

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Suppose the Distance of the Sun and Moon with the respective Altitudes of their lower Limbs were observed, as in the Margin, the 4th of April, 1786, the Eye being 18 Feet above the Water; the Ship in Latitude $34^{\circ} 17' N$. Longitude $17^{\circ} 46' W$. of Greenwich by Account, and the Watch not previously regulated, the Ship's true Longitude at the Time of Observation is required? Note. As the Sun was sufficiently distant from the Meridian, the Mean of the three Altitudes in the Margin may be supposed preferable to any single Observation for the Purpose of finding the true Time at the Ship.

	H. M. S.		Observed Alt. of Sun's Lower Limb Semi-diameter $16' 1''$ —Dip	Times.	Distance.	Sun's Alt.	Moon's Alt.
	4 50 57	1 11 4		H. M. S.	D. M. S.	D. M.	D. M.
Mean Time at the Ship Longitude $17^{\circ} 46' W$.				4 47 14	77 55 0	22 51	80 18
Reduced Time	6 2 1	N		4 50 11	77 57 0	22 12	80 36
Sun's Declination April 4th	5 51 59			4 55 26	78 2 10	21 6	81 09
Ditto, April 5th	6 14 45						
Difference in 24 Hours	0 22 46			14 32 51	233 54 10	66 09	242 03
As 24h. : $22' 46''$: 6h. :	2 0 5 42			4 50 57	77 58 3	22 3	80 41
Declination, April 4th	5 51 59						
Ditto at reduced Time	5 57 41						
Zenith Distance	67 47 13						
Polar Distance	84 2 19						
Comp. of the Latitude	55 43 0						
Sum	2) 207 32 32						
Half Sum	103 46 16						
Zenith Distance	67 47 13						
Difference	35 59 3						
True Time	4 28 29						
Longitude $17^{\circ} 46' W$.	1 11 4						
Reduced Time	5 39 33						

Moon's Semi-diam. at Noon 15 57	Hor. Par. 58 31
Ditto at Midnight 15 49	Ditto Midn. 58 03
Difference in 12 Hours 0 8	Ditto 0 28
Prop. Part for 5h. 39' 33" = 0 4	Ditto 0 13
Semi-diam. at Noon 15 57	Ditto 58 31
Semi-diam. at reduc. Time 15 53	Hor. Par. 58 18
Corr. by Table II 16	
Moon's true Semi-diam. 16 9	
Dip 4 3	
Difference 0 12 6	
Obs. Altitude 80 41	
Moon's Apparent Alt. 80 53 6	
Corrct. from Tab. III. 0 9 4	
Moon's true Altitude 81 2 10	

H. M. S.	22 3 0	0 11 58
Observed Alt. of Sun's Lower Limb	22 14 58	
Semi-diameter $16' 1''$ —Dip	2 11	
Sun's Apparent Altitude	22 12 47	
Cor. by Table I.	67 47 13	
Sun's true Altitude	34 17 0	
Zenith Distance	55 43 0	
Latitude		
Co. Lat.		
Ari. Co. Sine	0,00236	
Ari. Co. Sine	0,08288	
Log Sine of Half Sum	9,98733	
Log. Sine of Difference	9,76904	
Sum of 4 Logarithms	2) 19,84161	
$\frac{1}{2}$ Hor. Ang. $33^{\circ} 33' 40''$ = Co. sine of $\frac{1}{2}$ Sum 9,92080		
$\frac{1}{2}$ H. M. S.	67 7 20 = 4 28 29	
Time by Watch	4 50 57	
Watch fast	0 22 28	

To find the Distance.

Moon's Apparent Alt.	D. M. S.	Moon's true Altitude	D. M. S.	Distance at 3 Hours	D. M. S.	D. M. S.
Sun's Ditto	80 53 6	Sun's Ditto	81 2 10	Distance at 6 Hours	77 11 11	77 11 11
Difference	22 14 58	Difference	22 12 47	Difference in 3 Hours	78 45 40	78 45 40
Apparent Dist. of Centres	58 38 8	Half Difference	58 49 23	Then, as 10 34' 29" : 3 h. : :	Comp. Diff.	Comp. Diff.
Sum	78 30 13	Referved Logarithm	29 24 41	10. 10' 37"	1 34 29	1 34 29
Difference	137 8 21	Log. Sine of Half Sum	9,99292	Time standing over first Dist.	2h 14' 31"	2h 14' 31"
Half Sum	19 52 5	Log. Sine of Half Difference	9,96889	True Time at Greenwich	5 14 31	5 14 31
Half Difference	68 34 10	Sum 10 from the Index rejected	9,23681	Time at the Ship	4 28 29	4 28 29
Angle	23 25 14	To the Log. Sine of Half Sum	19,19862	Diff. of Time between the Ship and Greenwich	0 46 2	0 46 2
Half Difference of true Altitudes	29 24 41	Log. Co-fine	9,78115			
Sum	52 49 55	Log. Co-fine	9,99762			
Difference	5 59 27	2) 19,77877				
Half the true Distance	39 10 54	2) 19,77877				
True Distance	78 21 48					

$= 11^{\circ} 30' \frac{1}{2} W.$ because the Time is less at the Ship than at Greenwich.

EXAMPLE IV.

Suppose that about $\frac{3}{4}$ after 4 P. M. on the 10th of February 1786, in Latitude $54^{\circ} 25'$ South, Longitude by Account 10° East of Greenwich, the following Observations were made, the Error of the Instrument $24''$ to be added, and the Eye of the Observer 21 Feet above the Surface of the Sea, the true Time is required?

[illegible]

On the same Evening the following Observations were made of the Distance of the Star Regulus from the Moon's farthest Limb, Longitude by Account as before, and the Error of the Quadrants, by which the Moon's Altitude and the Distance were taken, 25" and 7' 30" to be added; Required the true Longitude?

Times.		Altitude of Regulus.		Altitude of the Moon's lower Limb.		Dist. of Moon's far. Limb from Regulus.	
H. M. S.	D. M. S.	D. M. S.	D. M. S.	D. M. S.	D. M. S.	D. M. S.	D. M. S.
10 56 14	19 50 30	18 6 0	31 30 43				
10 39 6	20 2 0	18 21 0	31 31 30				
10 41 41	20 15 0	18 39 30	31 33 0				
10 43 45	20 29 0	18 55 0	31 34 0				
10 45 53	20 40 0	19 9 0	31 35 45				
5) 53 26 39	101 16 30	93 10 30	157 44 58				
10 41 20	20 15 18	18 38 6	31 32 59				
— 0 15 57	Error of Quadrants.	+ 7 30	+ 0 25				
10 25 23	20 15 18	18 45 36	31 33 24				

Star's Observed Altitude 20 15 18
Dip 0 4 22

Star's Apparent Altitude 20 10 56
Refraction 0 2 34

Star's true Altitude 20 8 22

True time at the Ship Long. 10° E. in Time	H. M. S. 10 25 23 40 0								
Reduced Time	9 45 23								
Moon's Semi-diam. at Noon	0 15 31	Horizontal Parallax	0 56 58						
Ditto at Midnight	0 15 27	Ditto at Midnight	0 56 43						
Difference	0 0 4	Difference	0 0 15						
As 12h is to 4" :: 9h 45' 23" is to 15" :: 9h 45' 23" is to 12	0 0 3	As 12h. : 15" :: 9h. 45' 23" : 12	0 0 12						
Semi-diam. at Noon	0 15 31	Horizontal Parallax at Noon	0 56 58						
Ditto at Reduced Time	0 15 28	Ditto at Reduced Time	0 56 46						
Correction from Table II.	0 0 5		18 45 36						
Moon's true Semi-diam.	0 15 33	Moon's observed Altitude	15 33 7						
Moon's Dist. from Star	31 33 24	Semi-Diameter	15 33 7						
		Dip	11 11						
Apparent Distance	31 17 51	Apparent Altitude	18 56 47						
		Correction from Table III.	0 50 37						
		Moon's true Altitude	19 47 44						

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To find the Distance.

Moon's Apparent Altitude		Moon's true Altitude		D. M. S.		D. M. S.		Diff. at 9 Hours		D. M. S.	
Star's Ditto	18 56 47	20 10 56	Star's Ditto	19 47 44	20 8 22	Diff. at 9 Hours	31 40 12	31 40 12	Comp. Diff.	31 12 0	31 12 0
Difference	1 14 9	31 17 51	Difference	0 20 38	1 37 10	Diff. in 3 Hours	1 37 10	1 37 10	Comput. Diff.	0 28 12	0 28 12
Apparent Distance	32 32 0	30 3 42	Half Difference	0 10 19	0 10 19	As 1 37 10 : 3h. :: 0' 28' 12" : Time at first Distance	10 25 23	10 25 23	Time at Ship	9 52 14	9 52 14
Sum	15 1 51	15 1 51	Log. Sine	9,447 33	9,447 33	True Time at Greenwich	9 52 14	9 52 14	Greenwich Time	9 52 14	9 52 14
Difference	16 16 0	16 16 0	Log. Sine	9,413 87	9,413 87	Difference of Time between Ship and Greenwich	0 33 9	0 33 9			
Half Sum	15 1 51	15 1 51	Log. Sine	18,859 06	18,859 06						
Half Difference	15 35 45	15 35 45	Sum lefts Radius	9,429 53	9,429 53						
Angle	15 46 7	15 46 7	Log. Sine of Half Sum	9,983 34	9,983 34						
Difference of true Altitudes	15 25 29	15 25 29	Log. Co-sine	9,984 07	9,984 07						
Sum	15 36 0	15 36 0	Log. Co-sine	19,967 41	19,967 41						
Difference	15 36 0	15 36 0	Sum	9,983 70	9,983 70						
Half true Dist.	31 12 0	31 12 0	Log. Co-sine of Half Sum								
True Distance											

Which turned into Longitude is 8 17 ½ E.

The following is another Method for reducing the Apparent to the true Distance.

RULE. To the Nat. Co-sine of the Difference of the Apparent Altitudes, add the Nat. Co-sine of the Apparent Distance, when it is more than 90 Degrees, but subtract it when the Distance is less than 90; and then find the Logarithm of their Sum or Difference.

To this Logarithm add the Logarithms of the Co-sines of the true Altitudes, and from that Sum subtract the Sum of the Logarithms, Co sine of the Apparent Altitudes, and then find the Nat. Number of the remaining Logarithm; the Difference between this Number and the Nat. Co sine of the Difference of the true Altitudes, will be the Nat. Co-sine of the true Distance required.

To find the true Distance from that given in the last Example by this Rule.

From	Nat. Co-sine Diff. of apparent Altitudes	1° 14' 09" =	99977	
Take	Nat. Co-sine of the apparent Distance	31 17 51 =	85448	
	Difference of Nat. Co-sine		=	14529 Its Log. 4,16224
Add	Log. Co-sine of Moon's true Altitude	19 47 44 =	9,97355	
Sum	Log. Co-sine of Star's Ditto	20 08 22 =	9,97260	19,94615
	Their Sum			24,10839
Sub.	Log. Co-sine of Moon's apparent Alt.	18° 56' 47" =	9,97588	
Sum	Log. Co-sine of Star's Ditto	20 10 56 =	9,97248	19,94829
	Nat. Num. of the remaining Log.		=	14458 4,16010
	Nat. Co-sine of the Diff. of true Alts. 0° 20' 38" =		99998	
	Nat. Co-sine of the true Distance	31 11 44	85548	
	Preceding Distance at 9 Hours	31 40 12		31° 40' 12"
	Following Distance at 12 Hours	30 03 02	Computed Distance	31 11 44
	Difference in 3 Hours	1 37 10	Ditto Difference	0 28 28
	As 1° 37' 10" : 3 H :: 28' 28" =	0 52 44		
	Time standing over the preceding Diff.	9 00 00		
	Time at Greenwich	9 52 44		
	Time at the Ship	10 25 23		
	Difference in Time	0 32 39	Reduced into Longitude 8° 9' $\frac{3}{4}$ East.	

QUESTION I.

Being at Sea, April the 24th, 1786, in Longitude 46° 45' East of Greenwich by Account, at 6 H. 30 M. P. M. per Watch previously regulated by the Sun, the Distance of the Sun and Moon's nearest Limbs were observed to be 50° 57'; at the same Time the Altitude of

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of the Sun's lower Limb was $5^{\circ} 8' 30''$, and that of the Moon $42^{\circ} 18'$, the Eye being 18 Feet above the Surface of the Water. Required the Longitude in ?

Answer $\left\{ \begin{array}{l} \text{Long. in by Rule I. } 44^{\circ} 29' \text{ East} \\ \text{Ditto by Rule II. } 44 \quad 33 \text{ East} \end{array} \right\}$ of Greenw. or $\left\{ \begin{array}{l} 44 \quad 34 \text{ E.} \\ 44 \quad 35 \text{ E.} \end{array} \right\}$ London.

QUESTION II.

In the Evening of the 9th of October, 1786, in Longitude $12^{\circ} 45'$ E. of Greenwich by Account, at 6 H. $44' 30''$ per Watch previously regulated, the Distance of the Moon's nearest Limb from the Star Pollux was observed to be $64^{\circ} 30' 11''$, the Altitude of the Moon's lower Limb $40^{\circ} 38' 27''$, the Altitude of the Star $29^{\circ} 30' 16''$, the Eye being 20 Feet above the Sea. Required the true Longitude ?

Answer $\left\{ \begin{array}{l} \text{Longitude in by Rule I. } 12^{\circ} 44' 30' \text{ E. of Greenw.} \\ \text{Ditto by Rule II. } 12 \quad 42 \quad 45 \text{ E.} \end{array} \right\}$

QUESTION III.

In a Ship at Sea in Latitude $17^{\circ} 48'$ S. and Longitude $64^{\circ} 32'$ E. of Greenwich by Account, on September 4th, 1786, the Distance of the Moon's farthest Limb from the Star Pegasi Markab, with the Altitude of the Star then West of the Meridian, and also that of the Moon's lower Limb were observed as in the Margin ; the Eye being 12 Feet above the Water, and the Watch not regulated. Required the Ship's true Longitude at the Time of Observation ?

	Times.			Dist. of Moon and Star.			Alt. of Moon.			Alt. of Star.		
	H.	M.	S.	°	'	"	°	'	"	°	'	"
	14	50	30	54	32	42	15	22	0	35	22	00
	14	55	35	54	29	43	14	11	0	34	15	00
	15	0	0	54	27	8	13	8	0	33	17	00
	15	5	50	54	23	42	11	46	0	32	1	00
	15	11	15	54	20	31	10	30	0	30	50	00
Sums	75	3	10	272	13	46	64	57	0	165	45	00
Means	15	0	38	54	26	45	12	59	24	33	9	00

Answer $\left\{ \begin{array}{l} \text{True Time } 15 \text{ H. } 10' 7'' \text{ P. M. or } 3 \text{ Hours } 10' 7'' \\ \text{A. M. September 5th.} \end{array} \right\}$

Longitude by Rule I. $66^{\circ} 16' \text{ E.}$
Ditto by Rule II. $66 \quad 19 \quad \frac{1}{4} \text{ E.}$

Having obtained the true Time of the Day by the foregoing Operations, and as a tolerable Watch cannot be supposed to vary much in the Space of a few Hours, or even in a Day, the true Azimuth may easily be found at any convenient Time afterwards by the following Method.

As the Co-sine of the Sun's Altitude is to the Sine of the Hour from Noon, turned into Degrees, so is the Co-sine of the Sun's Declination to the Sine of the true Azimuth: As for Example: In Latitude $51^{\circ} 30' N.$ the Sun's Declination $15^{\circ} 10' N.$ at 2 Minutes past 6 in the Afternoon the Sun's Altitude was $11^{\circ} 30'$. Required the True Azimuth?

As Co-sine of Sun's Altitude	11 30	9,99119	Note. The Latitude is set down in this Question, in order to enable those who chuse to prove the Work by the common Method.
Is to Sine of the Hour 6h. 2m. =	90 30	9,99999	
So is the Co-sine of the Sun's Declination	15 10	9,98460	
		19,98459	
		9,99119	
To the Sine of the true Azimuth	80° 2' N.	9,99340	

A New Method for finding the Latitude by double Altitudes of the Sun.

Add together the Arithmetical Complement of Co-sine of Declination, the Arithmetical Complement of the common Logarithm of the Difference of the Co-sines of the Times from Noon, turned into Degrees and Minutes, and the common Logarithm of the Difference of the Natural Sines of both Altitudes; the Sum of these three Logarithms will give the Logarithm Co-sine of the Latitude required.

Note. The Arithmetical Complement of the Common Logarithm is found by subtracting that Logarithm from 10,00000.

Example in double Altitudes, Page 289.

Times	H. M.	H. M.	D. M.	Nat. Co-sines.	Nat. Sine both Alts.
10 2 is	1 58	from Noon, or	29 30	87086	73036
11 27 is	0 33	from Noon	8 15	98965	81055
Difference Nat. Co-sines of Times from Noon				11879	8019 Difference
Declination $11^{\circ} 7'$ The Arithm. Comp. of Log. Co-sine of which is					0,00848
Difference of Nat. Co-Sines				11879	Arithm. Comp. of the Log. 5,92518
Difference of Nat. Sines of both Alts.				8019	Its Com. Log. 3,90412
Lat. required 46 Degrees 30 Minutes = Log. Co-sine of					9,83778

Example 2, Page 262.

H. M.	H. M.	D. M.	Nat. Co-sines
10 20 to Correct Time is	1 40	from Noon or	23 0
1 10 is Ditto	1 10	from Ditto or	17 30
			90631
			95372
			4741
Arithmetical Comp. of Log. Co-sine Declination			0,01003
Arithmetical Comp. of 4741 the Diff. of Nat. Co-sines from Noon			6,32413
Com. Log. of Diff. Nat. Sines of both Altitudes			3141
			3,49707
Lat. required 47 Degrees 19 Minutes = Log. Co-sine of			9,83123

Table I.
Or Corrections to be subtracted from the Apparent Altitude of the Sun's Centre to reduce it to the True Altitude:

Apparent Alt. of Sun.	Correction to be subtracted.	Apparent Altitude of Sun.	Correction subtracted.
5 0	9 43	16 30	3 1
5 10	9 29	17 02	2 55
5 20	9 14	17 30	2 50
5 30	8 59	18 02	2 45
5 40	8 45	18 30	2 40
5 50	8 32	19 02	2 35
6 0	8 19	19 30	2 30
6 10	8 7	20 02	2 27
6 20	7 54	20 30	2 23
6 30	7 42	21 02	2 19
6 40	7 31	21 30	2 16
6 50	7 21	22 02	2 12
7 0	7 11	22 30	2 6
7 10	7 2	23 02	1 59
7 20	6 53	23 30	1 54
7 30	6 44	24 02	1 48
7 40	6 36	24 30	1 43
7 50	6 28	25 02	1 39
8 0	6 20	25 30	1 34
8 10	6 13	26 02	1 30
8 20	6 6	26 30	1 27
8 30	5 59	27 02	1 23
8 40	5 52	27 30	1 20
8 50	5 46	28 02	1 16
9 0	5 39	28 30	1 13
9 10	5 33	29 02	1 10
9 20	5 27	29 30	1 8
9 30	5 22	30 02	1 5
9 40	5 16	30 30	1 2
9 50	5 11	31 02	1 1
10 0	5 6	31 30	0 58
10 10	4 58	32 02	0 56
10 20	4 51	32 30	0 54
10 30	4 44	33 02	0 52
10 40	4 38	33 30	0 50
11 0	4 31	34 02	0 47
11 10	4 25	34 30	0 46
11 20	4 20	35 02	0 44
11 30	4 14	35 30	0 42
11 40	4 7	36 02	0 42
11 50	4 0	36 30	0 40
12 0	3 54	37 02	0 38
12 10	3 48	37 30	0 37
12 20	3 42	38 02	0 35
12 30	3 36	38 30	0 35
12 40	3 31	39 02	0 33
12 50	3 26	39 30	0 32
13 0	3 21	40 02	0 30
13 10	3 16	40 30	0 29
13 20	3 11	41 02	0 29
13 30	3 8	41 30	0 29

Table II.
Corrections to be added to the Moon's Semi-diameter.

Moon's Altitude.	Correction to be added.
0	0
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	2
9	2
10	3
11	3
12	3
13	4
14	4
15	4
16	4
17	5
18	5
19	5
20	5
21	6
22	6
23	6
24	6
25	7
26	7
27	7
28	7
29	8
30	8
31	8
32	8
33	9
34	9
35	9
36	9
37	10
38	10
39	10
40	10
41	10
42	11
43	11
44	11
45	12
46	12
47	12
48	13
49	13
50	13
51	14
52	14
53	14
54	15
55	15
56	15
57	16
58	16
59	16
60	16

Table I. is the Difference between the Refraction and Parallax, and is to be subtracted from the Apparent Altitude of the Sun, it may be found for any Degrees and Minutes by taking Proportional Parts.

Table II. contains the Numbers to be added to the Moon's Semi-diameter, because as in ascending from the Horizon to the Zenith she approaches nearer to the Observer, and consequently appears larger, these Numbers are the Natural Sines of her Altitude, the Radius being 16, which is nearly the Moon's Mean Semi-diameter.

Table III. contains the Difference between the Moon's Parallax and Refraction at each Degree of Altitude and every 10 Seconds of Horizontal Parallax; and may be found for any intermediate Minutes and Seconds by taking Proportional Parts, which must always be added to the Moon's Apparent Altitude to reduce it to the True Altitude.

Table IV. contains the Logarithms of the Arithmetical Complements of the Differences between the Logarithmic Co-fines of the Moon's True and Apparent Altitudes, at every Degree of Altitude. Every Tenth Second of Horizontal Parallax increased by 120, which Number is the Difference between Log. Co-fine of the True and Apparent Altitude of the fixed Stars when above 25 Degrees high.

In Table III. and IV. find the Apparent Altitude of the Moon at the Top, and the Horizontal Parallax in the Left Hand Column, and directly under the former and opposite to the latter stands the Correction in Table III, or the Logarithms in Table IV.

T A B L E III.
A TABLE of Corrections to be added to the Apparent Altitude
of the Moon's Centre, for reducing it to the true Altitude.

Apparent Altitude of the Moon's Centre.											
Moon's horizontal Parallax.		3°	4°	5°	6°	7°	8°	9°	10°	11°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	MS	MS	MS	MS	MS	MS	MS	MS	MS	
53	0	38.20	41.1	42.54	44.15	45.16	46.0	46.32	46.57	47.15	
	10	38.30	41.11	43.4	44.25	45.26	46.10	46.42	47.7	47.25	
	20	38.40	41.21	43.14	44.35	45.36	46.20	46.52	47.17	47.35	
	30	38.50	41.31	43.24	44.45	45.46	46.30	47.2	47.26	47.45	
	40	39.0	41.41	43.34	44.54	45.55	46.39	47.12	47.36	47.54	
	50	39.10	41.51	43.44	45.4	46.5	46.49	47.22	47.46	48.4	
54	0	39.20	42.1	43.53	45.14	46.15	46.59	47.32	47.56	48.14	
	10	39.30	42.11	44.3	45.24	46.25	47.9	47.42	48.6	48.24	
	20	39.40	42.21	44.13	45.34	46.35	47.19	47.51	48.16	48.34	
	30	39.50	42.31	44.23	45.44	46.45	47.29	48.1	48.26	48.43	
	40	40.0	42.41	44.33	45.54	46.55	47.38	48.11	48.35	48.53	
	50	40.10	42.51	44.43	46.4	47.5	47.48	48.21	48.45	49.3	
55	0	40.20	43.1	44.53	46.14	47.15	47.58	48.31	48.55	49.13	
	10	40.30	43.11	45.3	46.24	47.25	48.8	48.41	49.5	49.23	
	20	40.40	43.21	45.13	46.34	47.35	48.18	48.50	49.15	49.32	
	30	40.50	43.31	45.23	46.44	47.45	48.28	49.0	49.25	49.42	
	40	41.0	43.41	45.33	46.54	47.54	48.38	49.10	49.34	49.52	
	50	41.10	43.51	45.43	47.4	48.4	48.48	49.20	49.44	50.2	
56	0	41.20	44.1	45.53	47.14	48.14	48.58	49.30	49.54	50.12	
	10	41.30	44.11	46.3	47.24	48.24	49.7	49.40	50.4	50.21	
	20	41.40	44.21	46.13	47.34	48.34	49.17	49.50	50.14	50.31	
	30	41.50	44.31	46.23	47.44	48.44	49.27	49.59	50.24	50.41	
	40	42.0	44.41	46.33	47.54	48.54	49.37	50.9	50.34	50.51	
	50	42.10	44.51	46.43	48.3	49.4	49.47	50.19	50.43	51.1	
57	0	42.20	45.1	46.53	48.13	49.14	49.57	50.29	50.53	51.11	
	10	42.30	45.11	47.3	48.23	49.24	50.7	50.39	51.3	51.20	
	20	42.40	45.21	47.13	48.33	49.34	50.17	50.49	51.13	51.30	
	30	42.50	45.31	47.23	48.43	49.44	50.27	50.59	51.23	51.40	
	40	43.0	45.41	47.33	48.53	49.54	50.37	51.9	51.33	51.50	
	50	43.10	45.51	47.42	49.3	50.4	50.47	51.19	51.42	52.0	
58	0	43.20	46.0	47.52	49.13	50.14	50.57	51.29	51.52	52.9	
	10	43.30	46.10	48.2	49.23	50.24	51.6	51.38	52.2	52.19	
	20	43.40	46.20	48.12	49.33	50.34	51.16	51.48	52.12	52.29	
	30	43.50	46.30	48.22	49.43	50.43	51.26	51.58	52.22	52.39	
	40	44.0	46.40	48.32	49.53	50.53	51.36	52.8	52.32	52.49	
	50	44.10	46.50	48.42	50.3	51.3	51.46	52.18	52.41	52.59	
59	0	44.20	47.0	48.52	50.13	51.13	51.56	52.28	52.51	53.8	
	10	44.30	47.10	49.2	50.23	51.23	52.6	52.38	53.1	53.18	
	20	44.40	47.20	49.12	50.33	51.33	52.16	52.48	53.11	53.28	
	30	44.50	47.30	49.22	50.43	51.43	52.26	52.58	53.21	53.38	
	40	45.0	47.40	49.32	50.53	51.53	52.36	53.7	53.31	52.48	
	50	45.9	47.50	49.42	51.2	52.3	52.46	53.17	53.41	53.58	
60	0	45.19	48.0	49.52	51.12	52.13	52.56	53.27	53.50	54.7	
	10	45.29	48.10	50.2	51.22	52.23	53.5	53.37	54.0	54.17	
	20	45.39	48.20	50.12	51.32	52.33	53.15	53.47	54.10	54.27	
	30	45.49	48.30	50.22	51.42	52.43	53.25	53.57	54.20	54.37	
	40	45.59	48.40	50.32	51.52	52.52	53.35	54.7	54.30	54.47	
	50	46.9	48.50	50.42	52.2	53.2	53.45	54.16	54.40	54.57	
61	0	46.19	49.0	50.52	52.12	53.12	53.55	54.26	54.50	55.6	
	10	46.29	49.10	51.2	52.22	53.22	54.4	54.36	54.59	55.16	
	20	46.39	49.20	51.12	52.32	53.32	54.14	54.46	55.9	55.26	
	30	46.49	49.30	51.22	52.42	53.42	54.24	54.56	55.19	55.36	
	40	46.59	49.40	51.32	52.52	53.52	54.34	55.6	55.29	55.46	
	50	47.9	49.50	51.42	53.2	54.2	54.44	55.16	55.39	55.56	
62	0	47.19	50.0	51.52	53.12	54.12	54.54	55.26	55.49	56.5	

T A B L E III.

A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Alt.

Apparent Altitude of the Moon's Centre.

Moon's horizontal Parallax.		12°	13°	14°	15°	16°	17°	18°	19°	20°
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.
M	S.	M S	M S	M S	M S	M S	M S	M S	M S	M S
53	0	47.27	47.35	47.40	47.42	47.40	47.36	47.31	47.23	47.13
	10	47.37	47.45	47.50	47.52	47.50	47.46	47.41	47.33	47.22
	20	47.47	47.55	47.59	48.1	47.59	47.55	47.50	47.42	47.32
	30	47.56	48.4	48.9	48.11	48.9	48.5	48.0	47.52	47.41
	40	48.6	48.14	48.19	48.21	48.19	48.15	48.9	48.1	47.50
54	0	48.16	48.24	48.28	48.30	48.28	48.24	48.19	48.10	48.0
	10	48.26	48.34	48.38	48.40	48.38	48.34	48.28	48.20	48.9
	20	48.36	48.43	48.48	48.50	48.47	48.43	48.38	48.29	48.19
	30	48.45	48.53	48.58	48.59	48.57	48.53	48.47	48.39	48.28
	40	48.55	49.3	49.7	49.9	49.6	49.2	48.57	48.48	48.38
55	0	49.5	49.13	49.17	49.19	49.16	49.12	49.6	48.58	48.47
	10	49.15	49.22	49.27	49.28	49.26	49.21	49.16	49.7	48.57
	20	49.25	49.32	49.36	49.38	49.35	49.31	49.25	49.16	49.6
	30	49.34	49.42	49.46	49.48	49.45	49.41	49.35	49.25	49.16
	40	49.44	49.52	49.56	49.57	49.54	49.50	49.44	49.35	49.25
56	0	49.54	50.1	50.5	50.7	50.4	50.0	49.54	49.44	49.34
	10	50.4	50.11	50.15	50.16	50.14	50.10	50.3	49.53	49.44
	20	50.14	50.21	50.25	50.26	50.23	50.19	50.13	50.3	49.53
	30	50.23	50.31	50.35	50.36	50.33	50.29	50.22	50.13	50.2
	40	50.33	50.41	50.44	50.45	50.42	50.38	50.32	50.22	50.12
57	0	50.43	50.50	50.54	50.55	50.52	50.48	50.41	50.32	50.21
	10	50.53	51.0	51.4	51.5	51.2	50.57	50.51	50.41	50.31
	20	51.2	51.10	51.13	51.14	51.11	51.7	51.0	50.51	50.40
	30	51.12	51.20	51.23	51.24	51.21	51.16	51.10	51.0	50.50
	40	51.22	51.29	51.33	51.34	51.31	51.26	51.19	51.10	50.59
58	0	51.32	51.39	51.42	51.43	51.40	51.35	51.29	51.19	51.8
	10	51.42	51.49	51.52	51.53	51.50	51.45	51.38	51.29	51.18
	20	51.51	51.59	52.2	52.2	51.59	51.54	51.48	51.38	51.27
	30	52.1	52.8	52.11	52.12	52.9	52.4	51.57	51.47	51.37
	40	52.11	52.18	52.21	52.22	52.19	52.14	52.7	51.57	51.46
59	0	52.28	52.38	52.41	52.41	52.38	52.33	52.26	52.16	52.55
	10	52.30	52.47	52.50	52.51	52.48	52.43	52.35	52.25	52.14
	20	52.40	52.57	53.0	53.0	52.57	52.52	52.45	52.35	52.23
	30	52.50	53.7	53.10	53.10	53.7	53.2	52.54	52.44	52.33
	40	53.0	53.17	53.19	53.20	53.17	53.11	53.4	52.54	52.42
60	0	53.19	53.26	53.29	53.29	53.26	53.21	53.13	53.3	52.51
	10	53.29	53.36	53.39	53.39	53.36	53.30	53.23	53.13	53.1
	20	53.39	53.46	53.49	53.49	53.46	53.40	53.32	53.22	53.10
	30	53.49	53.56	53.58	53.58	53.55	53.50	53.42	53.32	53.20
	40	53.58	54.5	54.8	54.8	54.5	53.59	53.51	53.41	53.29
61	0	54.8	54.15	54.18	54.18	54.14	54.9	54.1	53.51	53.39
	10	54.18	54.25	54.28	54.27	54.24	54.18	54.10	54.0	53.48
	20	54.28	54.35	54.37	54.37	54.34	54.28	54.20	54.9	53.57
	30	54.38	54.44	54.47	54.47	54.43	54.38	54.29	54.19	54.7
	40	54.47	54.54	54.57	54.56	54.53	54.47	54.39	54.28	54.16
62	0	54.57	55.4	55.6	55.6	55.2	54.57	54.48	54.38	54.25
	10	55.7	55.14	55.16	55.16	55.12	55.6	54.58	54.47	54.35
	20	55.17	55.23	55.26	55.25	55.21	55.16	55.7	54.57	54.44
	30	55.27	55.33	55.35	55.35	55.31	55.25	55.17	55.6	54.53
	40	55.36	55.43	55.45	55.45	55.41	55.35	55.26	55.15	55.3
63	0	55.46	55.53	55.55	55.54	55.50	55.45	55.36	55.25	55.12
	10	55.56	56.2	56.4	56.4	56.0	55.54	55.45	55.34	55.21
	20	56.6	56.12	56.14	56.14	56.9	56.4	55.55	55.44	55.31
	30	56.16	56.22	56.24	56.23	56.19	56.13	56.4	55.53	55.40
	40	56.26	56.32	56.34	56.33	56.29	56.23	56.14	56.03	55.50

T A B L E — III.
A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.									
		21°	22°	23°	24°	25°	26°	27°	28°	29°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	M S	M S	M S	S	M S	S	M S	M S	M S	
53	0	47. 2	46. 48	46. 33	46. 18	46. 0	45. 42	45. 22	45. 1	44. 39	
	10	47. 11	46. 57	46. 42	46. 27	46. 9	45. 51	45. 31	45. 10	44. 48	
	20	47. 21	47. 7	46. 52	46. 36	46. 18	46. 0	45. 40	45. 19	44. 56	
	30	47. 30	47. 16	47. 1	46. 44	46. 27	46. 9	45. 49	45. 27	45. 5	
	40	47. 39	47. 25	47. 1	46. 54	46. 36	46. 18	45. 58	45. 36	45. 13	
	50	47. 49	47. 34	47. 19	47. 3	46. 45	46. 27	46. 7	45. 45	45. 22	
54	0	47. 58	47. 44	47. 29	47. 12	46. 55	46. 36	46. 16	45. 54	45. 31	
	10	48. 7	47. 53	47. 38	47. 22	47. 4	46. 45	46. 24	46. 3	45. 39	
	20	48. 17	48. 2	47. 47	47. 31	47. 13	46. 54	46. 33	46. 12	45. 48	
	30	48. 26	48. 12	47. 57	47. 40	47. 22	47. 3	46. 42	46. 21	45. 57	
	40	48. 35	48. 21	48. 6	47. 49	47. 31	47. 12	46. 51	46. 29	46. 6	
	50	48. 45	48. 30	48. 15	47. 58	47. 40	47. 21	47. 0	46. 38	46. 15	
55	0	48. 54	48. 39	48. 24	48. 7	47. 49	47. 30	47. 9	46. 47	46. 24	
	10	49. 4	48. 49	48. 33	48. 16	47. 58	47. 39	47. 18	46. 56	46. 32	
	20	49. 13	48. 58	48. 42	48. 25	48. 7	47. 48	47. 27	47. 5	46. 41	
	30	49. 22	49. 7	48. 52	48. 35	48. 17	47. 57	47. 36	47. 13	46. 50	
	40	49. 32	49. 17	49. 1	48. 44	48. 26	48. 6	47. 45	47. 22	46. 58	
	50	49. 41	49. 26	49. 20	48. 53	48. 35	48. 15	47. 54	47. 31	47. 7	
56	0	49. 50	49. 35	49. 19	49. 2	48. 44	48. 24	48. 3	47. 40	47. 16	
	10	49. 59	49. 44	49. 28	49. 11	48. 53	48. 33	48. 12	47. 49	47. 25	
	20	50. 9	49. 54	49. 38	49. 20	49. 2	48. 42	48. 20	47. 58	47. 34	
	30	50. 18	50. 3	49. 47	49. 29	49. 11	48. 51	48. 29	48. 7	47. 42	
	40	50. 27	50. 12	49. 56	49. 39	49. 20	49. 0	48. 38	48. 15	47. 51	
	50	50. 37	50. 22	50. 5	49. 48	49. 29	49. 9	48. 47	48. 24	48. 0	
57	0	50. 46	50. 31	50. 14	49. 57	49. 38	49. 18	48. 56	48. 33	48. 9	
	10	50. 55	50. 40	50. 23	50. 6	49. 47	49. 27	49. 5	48. 42	48. 17	
	20	51. 5	50. 49	50. 33	50. 15	49. 56	49. 3	49. 14	48. 51	48. 26	
	30	51. 14	50. 59	50. 42	50. 24	50. 5	49. 45	49. 23	49. 0	48. 35	
	40	51. 23	51. 8	50. 51	50. 34	50. 14	49. 54	49. 31	49. 8	48. 44	
	50	51. 33	51. 17	51. 1	50. 43	50. 23	50. 3	49. 40	49. 17	48. 52	
58	0	51. 42	51. 26	51. 10	50. 52	50. 32	50. 12	49. 49	49. 26	49. 1	
	10	51. 51	51. 36	51. 19	51. 1	50. 41	50. 21	49. 58	49. 35	49. 9	
	20	52. 1	51. 45	51. 28	51. 10	50. 50	50. 30	50. 7	49. 44	49. 18	
	30	52. 10	51. 54	51. 37	51. 19	50. 59	50. 39	50. 16	49. 53	49. 27	
	40	52. 19	52. 4	51. 47	51. 29	51. 9	50. 47	50. 25	50. 1	49. 36	
	50	52. 29	52. 13	51. 56	51. 38	51. 18	50. 56	50. 34	50. 10	49. 45	
59	0	52. 38	52. 22	52. 5	51. 47	51. 27	51. 5	50. 43	50. 19	49. 54	
	10	52. 47	52. 31	52. 14	51. 56	51. 36	51. 14	50. 51	50. 28	50. 2	
	20	52. 57	52. 41	52. 23	52. 5	51. 45	51. 23	51. 0	50. 37	50. 11	
	30	53. 6	52. 50	52. 32	52. 14	51. 54	51. 32	51. 9	50. 46	50. 20	
	40	53. 15	52. 59	52. 41	52. 23	52. 3	51. 41	51. 18	50. 54	50. 29	
	50	53. 25	53. 9	52. 51	52. 32	52. 12	51. 50	51. 27	51. 3	50. 37	
60	0	53. 34	53. 18	53. 0	52. 41	52. 21	51. 59	51. 36	51. 12	50. 46	
	10	53. 43	53. 27	53. 9	52. 51	52. 3	52. 8	51. 45	51. 21	50. 55	
	20	53. 53	53. 36	53. 18	53. 0	52. 39	52. 17	51. 54	51. 30	51. 4	
	30	54. 2	53. 45	53. 27	53. 9	52. 48	52. 26	52. 3	51. 39	51. 12	
	40	54. 11	53. 55	53. 37	53. 18	52. 57	52. 35	52. 12	51. 47	51. 21	
	50	54. 21	54. 4	53. 46	53. 27	53. 6	52. 44	52. 21	51. 56	51. 30	
61	0	54. 30	54. 13	53. 55	53. 36	53. 15	52. 53	52. 30	52. 5	51. 39	
	10	54. 39	54. 22	54. 4	53. 45	53. 25	53. 2	52. 38	52. 14	51. 47	
	20	54. 49	54. 32	54. 14	53. 55	53. 34	53. 11	52. 47	52. 23	51. 56	
	30	54. 58	54. 41	54. 23	54. 4	53. 43	53. 20	52. 56	52. 32	52. 5	
	40	55. 7	54. 50	54. 32	54. 13	53. 52	53. 29	53. 5	52. 40	52. 14	
	50	55. 17	55. 0	54. 42	54. 22	54. 1	53. 38	53. 14	52. 49	52. 22	
62	0	55. 26	55. 9	54. 51	54. 31	54. 10	53. 47	53. 23	52. 58	52. 31	

T A B L E III.
A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Apparent Altitude of the Moon's Centre.											
Moon's horizontal Parallax.		30°	31°	32°	33°	34°	35°	36°	37°	38°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	M S	M S	M S	M S	M S	M S	M S	M S	M S	M S
53	0	44.15	43.51	43.26	42.59	42.32	42.3	41.34	41.4	40.33	
	10	44.24	44.0	43.34	43.7	42.40	42.11	41.42	41.12	40.41	
	20	44.33	44.8	43.43	43.16	42.48	42.19	41.50	41.20	40.49	
	30	44.41	44.17	43.51	43.24	42.57	42.28	41.59	41.28	40.56	
	40	44.50	44.26	44.0	43.33	43.5	42.36	42.7	41.36	41.4	
	50	44.59	44.34	44.8	43.41	43.13	42.44	42.15	41.44	41.12	
54	0	45.7	44.43	44.16	43.50	43.22	42.53	42.23	41.52	41.20	
	10	45.16	44.51	44.25	43.58	43.30	43.1	42.32	42.0	41.28	
	20	45.25	45.0	44.33	44.7	43.38	43.9	42.40	42.8	41.36	
	30	45.33	45.8	44.42	44.13	43.47	43.18	42.48	42.16	41.43	
	40	45.42	45.17	44.50	44.23	43.55	43.26	42.56	42.24	41.51	
	50	45.51	45.25	44.59	44.32	44.3	43.34	43.4	42.32	41.59	
55	0	45.59	45.34	45.7	44.40	44.11	43.42	43.12	42.40	42.7	
	10	46.8	45.43	45.16	44.48	44.20	43.50	43.20	42.48	42.15	
	20	46.17	45.51	45.24	44.57	44.28	43.58	43.28	42.56	42.23	
	30	46.25	46.0	45.33	45.5	44.36	44.6	43.36	43.4	42.31	
	40	46.34	46.8	45.41	45.13	44.45	44.15	43.44	43.12	42.39	
	50	46.43	46.17	45.9	45.21	44.53	44.23	43.52	43.20	42.47	
56	0	46.51	46.25	45.58	45.30	45.1	44.31	44.0	43.28	42.55	
	10	47.0	46.34	46.6	45.39	45.9	44.39	44.8	43.36	43.2	
	20	47.9	46.42	46.15	45.47	45.17	44.47	44.16	43.44	43.10	
	30	47.17	47.51	46.23	45.55	45.26	44.55	44.24	43.52	43.18	
	40	47.26	47.0	46.32	46.4	45.34	45.4	44.32	44.0	43.26	
	50	47.35	47.8	46.40	46.12	45.42	45.12	44.40	44.8	43.34	
57	0	47.43	47.17	46.49	46.21	45.51	45.20	44.48	44.16	43.42	
	10	47.52	47.25	46.57	46.29	46.0	45.28	44.57	44.24	43.50	
	20	48.1	47.34	47.6	46.38	46.8	45.36	45.5	44.32	43.58	
	30	48.9	47.43	47.14	46.46	46.16	45.45	45.13	44.40	44.5	
	40	48.18	47.51	47.23	46.54	46.25	45.53	45.21	44.47	44.13	
	50	48.27	48.0	47.31	47.3	46.33	46.1	45.29	44.55	44.21	
58	0	48.35	48.8	47.40	47.11	46.41	46.9	45.37	45.3	44.29	
	10	48.44	48.17	47.48	47.19	46.49	46.17	45.45	45.11	44.37	
	20	48.53	48.26	47.57	47.28	46.57	46.25	45.53	45.19	44.45	
	30	49.1	48.34	48.5	47.36	47.6	46.33	46.1	45.27	44.53	
	40	49.10	48.43	48.14	47.44	47.14	46.42	46.9	45.35	45.1	
	50	49.19	48.52	48.22	47.53	47.22	46.50	46.17	45.43	45.8	
59	0	49.27	49.0	48.31	48.1	47.30	46.58	46.25	45.51	45.16	
	10	49.30	49.9	48.39	48.10	47.39	47.6	46.33	45.59	45.24	
	20	49.45	49.17	48.48	48.18	47.47	47.14	46.41	46.7	45.32	
	30	49.53	49.26	48.56	48.27	47.55	47.23	46.50	46.15	45.40	
	40	50.2	49.34	49.5	48.35	48.4	47.31	46.58	46.23	45.48	
	50	50.11	49.42	49.13	48.43	48.12	47.39	47.6	46.31	45.56	
60	0	50.19	49.51	49.22	48.52	48.20	47.47	47.14	46.39	46.4	
	10	50.28	49.59	49.30	49.0	48.29	47.55	47.22	46.47	46.11	
	20	50.37	50.8	49.39	49.8	48.37	48.4	47.30	46.55	46.19	
	30	50.45	50.17	49.47	49.17	48.45	48.12	47.38	47.3	46.27	
	40	50.54	50.26	49.56	49.25	48.54	48.20	47.46	47.11	46.35	
	50	51.3	50.34	50.4	49.34	49.2	48.28	47.54	47.19	46.43	
61	0	51.11	50.43	50.13	49.42	49.10	48.37	48.2	47.27	46.51	
	10	51.20	50.51	50.21	49.50	49.18	48.45	48.10	47.35	46.59	
	20	51.29	51.0	50.30	49.59	49.27	48.53	48.18	47.43	47.7	
	30	51.37	51.8	50.38	50.7	49.35	49.1	48.27	47.51	47.15	
	40	51.46	51.17	50.47	50.15	49.43	49.9	48.35	47.59	47.23	
	50	51.55	51.25	50.55	50.24	49.52	49.18	48.43	48.7	47.31	
62	0	52.3	51.34	51.4	50.32	50.0	49.26	48.51	48.15	47.39	

T A B L E III.
A TABLE of Corrections to be added to the apparent Altitude of
the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.									
		39°	40°	41°	42°	43°	44°	45°	46°	47°	
		Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. M S	Corr. S
53	0	40. 1	39. 28	38. 54	38. 20	37. 44	37. 8	36. 32	35. 54	35. 16	
	10	40. 8	39. 36	39. 2	38. 27	37. 51	37. 15	36. 39	36. 1	35. 22	
	20	40. 16	39. 43	39. 9	38. 34	37. 59	37. 23	36. 46	36. 8	35. 29	
	30	40. 24	39. 51	39. 17	38. 42	38. 6	37. 30	36. 53	36. 15	35. 36	
	40	40. 32	39. 59	39. 25	38. 49	38. 13	37. 37	37. 0	36. 22	35. 43	
	50	40. 39	40. 0	39. 32	38. 57	38. 21	37. 44	37. 7	36. 29	35. 50	
54	0	40. 47	40. 14	39. 40	39. 4	38. 28	37. 52	37. 14	36. 35	35. 56	
	10	40. 55	40. 22	39. 47	39. 12	38. 35	37. 59	37. 21	36. 42	36. 3	
	20	41. 3	40. 29	39. 55	39. 19	38. 43	38. 6	37. 28	36. 49	36. 10	
	30	41. 10	40. 37	40. 2	39. 27	38. 50	38. 13	37. 35	36. 56	36. 17	
	40	41. 18	40. 45	40. 10	39. 34	38. 57	38. 20	37. 42	37. 3	36. 24	
	50	41. 26	40. 52	40. 17	39. 42	39. 5	38. 28	37. 49	37. 10	36. 31	
55	0	41. 34	41. 0	40. 25	39. 49	39. 12	38. 35	37. 56	37. 17	36. 37	
	10	41. 42	41. 8	40. 32	39. 57	39. 19	38. 42	38. 4	37. 24	36. 44	
	20	41. 49	41. 15	40. 40	40. 4	39. 27	38. 49	38. 11	37. 31	36. 51	
	30	41. 57	41. 23	40. 47	40. 12	39. 34	38. 56	38. 18	37. 38	36. 58	
	40	42. 5	41. 31	40. 55	40. 19	39. 41	39. 4	38. 25	37. 45	37. 5	
	50	42. 13	41. 38	41. 2	40. 27	39. 49	39. 11	38. 32	37. 52	37. 12	
56	0	42. 21	41. 46	41. 10	40. 34	39. 56	39. 18	38. 39	37. 59	37. 18	
	10	42. 28	41. 54	41. 18	40. 41	40. 3	39. 25	38. 46	38. 6	37. 25	
	20	42. 36	42. 1	41. 25	40. 49	40. 11	39. 32	38. 53	38. 13	37. 32	
	30	42. 44	42. 9	41. 33	40. 50	40. 18	39. 40	39. 0	38. 20	37. 39	
	40	42. 52	42. 17	41. 41	41. 3	40. 25	39. 47	39. 7	38. 27	37. 40	
	50	43. 0	42. 24	41. 49	41. 11	40. 33	39. 54	39. 14	38. 34	37. 53	
57	0	43. 7	42. 32	41. 56	41. 18	40. 40	40. 1	39. 21	38. 41	37. 59	
	10	43. 15	42. 40	42. 4	41. 26	40. 47	40. 8	39. 29	38. 47	38. 6	
	20	43. 23	42. 47	42. 11	41. 33	40. 55	40. 15	39. 36	38. 54	38. 13	
	30	43. 31	42. 55	42. 19	41. 40	41. 2	40. 23	39. 43	39. 1	38. 20	
	40	43. 38	43. 3	42. 26	41. 48	41. 9	40. 30	39. 50	39. 8	38. 27	
	50	43. 46	43. 10	42. 34	41. 55	41. 17	40. 37	39. 57	39. 15	38. 34	
58	0	43. 54	43. 18	42. 41	42. 3	41. 24	40. 44	40. 4	39. 22	38. 40	
	10	44. 2	43. 26	42. 49	42. 10	41. 31	40. 51	40. 11	39. 29	38. 47	
	20	44. 9	43. 33	42. 56	42. 17	41. 39	40. 59	40. 18	39. 36	38. 54	
	30	44. 17	43. 41	43. 4	42. 25	41. 46	41. 6	40. 25	39. 43	39. 1	
	40	44. 25	43. 49	43. 11	42. 32	41. 53	41. 13	40. 32	39. 50	39. 8	
	50	44. 33	43. 56	43. 19	42. 40	42. 1	41. 20	40. 39	39. 57	39. 15	
59	0	44. 41	44. 4	43. 26	42. 47	42. 8	41. 27	40. 46	40. 4	39. 21	
	10	44. 48	44. 12	43. 34	42. 54	42. 15	41. 35	40. 54	40. 11	39. 28	
	20	44. 56	44. 19	43. 41	43. 2	42. 23	41. 42	41. 1	40. 18	39. 35	
	30	45. 4	44. 27	43. 49	43. 9	42. 30	41. 49	41. 8	40. 25	39. 42	
	40	45. 12	44. 35	43. 56	43. 17	42. 37	41. 56	41. 15	40. 32	39. 49	
	50	45. 20	44. 42	44. 4	43. 24	42. 44	42. 3	41. 22	40. 39	39. 56	
60	0	45. 27	44. 50	44. 11	43. 32	42. 52	42. 11	41. 29	40. 46	40. 2	
	10	45. 35	44. 58	44. 19	43. 39	42. 59	42. 18	41. 36	40. 52	40. 9	
	20	45. 43	45. 5	44. 27	43. 47	43. 6	42. 25	41. 43	40. 59	40. 16	
	30	45. 51	45. 13	44. 35	43. 54	43. 14	42. 32	41. 50	41. 6	40. 23	
	40	45. 59	45. 21	44. 42	44. 2	43. 21	42. 39	41. 57	41. 13	40. 30	
	50	46. 7	45. 28	44. 49	44. 9	43. 28	42. 47	41. 4	41. 20	40. 37	
61	0	46. 14	45. 36	44. 57	44. 17	43. 36	42. 54	42. 11	41. 27	40. 43	
	10	46. 22	45. 44	45. 4	44. 24	43. 43	43. 1	42. 18	41. 34	40. 50	
	20	46. 30	45. 51	45. 12	44. 31	43. 50	43. 8	42. 25	41. 41	40. 57	
	30	46. 38	45. 59	45. 19	44. 39	43. 58	43. 15	42. 32	41. 48	41. 4	
	40	46. 45	46. 7	45. 27	44. 46	44. 5	43. 23	42. 39	41. 55	41. 11	
	50	46. 53	46. 14	45. 34	44. 54	44. 12	43. 30	42. 46	42. 2	41. 18	
62	0	47. 1	46. 22	45. 42	45. 1	44. 19	43. 37	42. 53	42. 9	41. 24	

T A B L E III.

A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre									
		48°	49°	50°	51°	52°	53°	54°	55°	56°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	M S	M S	M S	M S	M S	M S	M S	M S	M S	
53	0	34.37	33.57	33.16	32.35	31.54	31.11	30.28	29.44	29.0	
	10	34.43	34.4	33.22	32.41	32.0	31.17	30.34	29.50	29.6	
	20	34.50	34.10	33.29	32.47	32.6	31.23	30.40	29.56	29.11	
	30	34.56	34.17	33.35	32.54	32.12	31.29	30.46	30.1	29.17	
	40	35.3	34.23	33.42	33.0	32.18	31.35	30.52	30.7	29.22	
	50	35.10	34.30	33.48	33.6	32.24	31.41	30.58	30.13	29.28	
54	0	35.17	34.36	33.55	33.13	32.30	31.47	31.3	30.19	29.33	
	10	35.23	34.43	34.1	33.19	32.37	31.53	31.9	30.24	29.39	
	20	35.30	34.49	34.8	33.25	32.43	31.59	31.15	30.30	29.45	
	30	35.37	34.56	34.14	33.32	32.49	32.5	31.21	30.36	29.50	
	40	35.43	35.2	34.21	33.38	32.55	32.11	31.27	30.42	29.56	
	50	35.50	35.9	34.27	33.44	33.1	32.17	31.33	30.47	30.1	
55	0	35.57	35.16	34.34	33.51	33.7	32.23	31.39	30.53	30.7	
	10	36.3	35.22	34.40	33.57	33.14	32.29	31.44	30.59	30.12	
	20	36.10	35.29	34.47	34.3	33.20	32.35	31.50	31.4	30.18	
	30	36.17	35.35	34.53	34.10	33.26	32.41	31.56	31.10	30.24	
	40	36.23	35.42	34.59	34.16	33.32	32.47	32.2	31.16	30.29	
	50	36.30	35.48	35.6	34.22	33.38	32.53	32.2	31.22	30.35	
56	0	36.37	35.55	35.12	34.29	33.44	32.59	32.14	31.28	30.41	
	10	36.43	36.1	35.19	34.35	33.51	33.6	32.20	31.33	30.46	
	20	36.50	36.8	35.25	34.41	33.57	33.12	32.26	31.39	30.52	
	30	36.57	36.14	35.31	34.48	34.3	33.18	32.31	31.45	30.57	
	40	37.3	36.21	35.38	34.54	34.9	33.24	32.37	31.50	31.3	
	50	37.10	36.28	35.44	35.0	34.15	33.30	32.43	31.56	31.8	
57	0	37.17	36.34	35.51	35.6	34.21	33.36	32.49	32.2	31.14	
	10	37.23	36.41	35.57	35.12	34.28	33.42	32.55	32.8	31.19	
	20	37.30	36.47	36.3	35.19	34.34	33.48	33.1	32.13	31.25	
	30	37.37	36.54	36.10	35.25	34.40	33.54	33.7	32.19	31.31	
	40	37.43	37.1	36.16	35.31	34.46	34.0	33.13	32.25	31.36	
	50	37.50	37.7	36.22	35.37	34.52	34.6	33.18	32.30	31.42	
58	0	37.57	37.14	36.29	35.44	34.58	34.12	33.24	32.36	31.48	
	10	38.3	37.20	36.35	35.50	35.5	34.18	33.30	32.42	31.53	
	20	38.10	37.27	36.42	35.56	35.11	34.24	33.36	32.48	31.59	
	30	38.17	37.33	36.48	36.3	35.17	34.30	33.4	32.53	32.4	
	40	38.23	37.40	36.55	36.9	35.23	34.36	33.48	32.59	32.10	
	50	38.30	37.46	37.1	36.15	35.29	34.42	33.54	33.5	32.15	
59	0	38.37	37.53	37.8	36.22	35.35	34.48	34.0	33.11	32.21	
	10	38.43	37.59	37.14	36.28	35.42	34.54	34.5	33.16	32.27	
	20	38.50	38.6	37.21	36.34	35.48	35.0	34.11	33.22	32.32	
	30	38.57	38.13	37.27	36.41	35.54	35.6	34.17	33.28	32.38	
	40	39.4	38.19	37.33	36.47	36.0	35.12	34.23	33.33	32.43	
	50	39.11	38.26	37.40	36.53	36.6	35.18	34.29	33.39	32.49	
60	0	39.18	38.32	37.46	37.0	36.12	35.24	34.35	33.45	32.55	
	10	39.24	38.39	37.53	37.6	36.19	35.30	34.40	33.51	33.0	
	20	39.31	38.45	37.59	37.12	36.25	35.36	34.46	33.57	33.6	
	30	39.38	38.52	38.6	37.18	36.31	35.42	34.51	34.3	33.11	
	40	39.44	38.59	38.12	37.25	36.37	35.48	34.58	34.8	33.17	
	50	39.51	39.5	38.19	37.31	36.43	35.54	35.4	34.14	33.22	
61	0	39.58	39.12	38.25	37.37	36.49	36.0	35.10	34.20	33.28	
	10	40.4	39.18	38.32	37.44	36.56	36.6	35.15	34.25	33.34	
	20	40.11	39.25	38.38	37.50	37.2	36.12	35.21	34.31	33.39	
	30	40.18	39.31	38.44	37.56	37.8	36.18	35.27	34.37	33.45	
	40	40.24	39.38	38.50	38.3	37.14	36.24	35.33	34.42	33.50	
	50	40.31	39.44	38.57	38.9	37.20	36.30	35.39	34.48	33.56	
62	0	40.38	39.51	39.3	38.15	37.26	36.36	35.45	34.54	34.2	

T A B L E III.
A TABLE of Corrections to be added to the apparent Altitude of
the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.									
		57°	58°	59°	60°	61°	62°	63°	64°	65°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	M S	M S	M S	M S	M S	M S	M S	M S	M S	
53	0	28.15	27.30	26.44	25.57	25.10	24.22	23.35	22.46	21.57	
	10	28.20	27.35	26.49	26.2	25.15	24.27	23.39	22.50	22.1	
	20	28.26	27.40	26.54	26.7	25.20	24.32	23.44	22.55	22.5	
	30	28.31	27.46	26.59	26.12	25.25	24.36	23.48	22.59	22.10	
	40	28.37	27.51	27.4	26.17	25.30	24.41	23.53	23.3	22.14	
	50	28.42	27.56	27.9	26.22	25.35	24.46	23.57	23.8	22.18	
54	0	28.48	28.1	27.14	26.27	25.39	24.51	24.2	23.12	22.23	
	10	28.53	28.7	27.20	26.32	25.44	24.55	24.6	23.17	22.27	
	20	28.59	28.12	27.25	26.37	25.49	25.0	24.11	23.21	22.31	
	30	29.4	28.17	27.30	26.42	25.55	25.5	24.15	23.26	22.36	
	40	29.9	28.23	27.35	26.47	25.59	25.9	24.20	23.30	22.40	
	50	29.15	28.28	27.40	26.52	26.3	25.14	24.24	23.34	22.44	
55	0	29.20	28.33	27.45	26.57	26.8	25.19	24.29	23.39	22.48	
	10	29.26	28.38	27.50	27.2	26.13	25.23	24.33	23.43	22.52	
	20	29.31	28.44	27.56	27.7	26.18	25.28	24.38	23.47	22.57	
	30	29.36	28.49	28.1	27.12	26.23	25.32	24.42	23.52	23.1	
	40	29.42	28.54	28.6	27.17	26.28	25.37	24.47	23.56	23.5	
	50	29.47	29.0	28.11	27.22	26.33	25.42	24.51	24.0	23.9	
56	0	29.53	29.5	28.16	27.27	26.37	25.47	24.56	24.5	23.13	
	10	29.58	29.10	28.22	27.32	26.42	25.51	25.0	24.9	23.18	
	20	30.4	29.16	28.27	27.37	26.47	25.56	25.5	24.13	23.22	
	30	30.9	29.21	28.32	27.42	26.52	26.1	25.9	24.18	23.26	
	40	30.15	29.26	28.37	27.47	26.57	26.5	25.14	24.22	23.31	
	50	30.20	29.31	28.42	27.52	27.2	26.10	25.19	24.26	23.35	
57	0	30.26	29.37	28.47	27.57	27.6	26.15	25.23	24.31	23.39	
	10	30.31	29.42	28.53	28.2	27.11	26.19	25.28	24.35	23.43	
	20	30.37	29.47	28.58	28.7	27.16	26.24	25.32	24.40	23.47	
	30	30.42	29.53	29.3	28.12	27.21	26.29	25.37	24.44	23.52	
	40	30.47	29.58	29.8	28.17	27.26	26.33	25.42	24.49	23.56	
	50	30.53	30.3	29.13	28.22	27.31	26.38	25.46	24.53	24.0	
58	0	30.58	30.9	29.18	28.27	27.35	26.43	25.51	24.58	24.4	
	10	31.4	30.14	29.24	28.32	27.40	26.47	25.55	25.2	24.8	
	20	31.9	30.19	29.29	28.37	27.45	26.52	26.0	25.6	24.13	
	30	31.15	30.24	29.34	28.42	27.50	26.57	26.4	25.11	24.17	
	40	31.20	30.30	29.39	28.47	27.55	27.1	26.9	25.15	24.21	
	50	31.26	30.35	29.44	28.52	28.0	27.6	26.13	25.19	24.25	
59	0	31.31	30.40	29.49	28.57	28.4	27.11	26.18	25.24	24.30	
	10	31.37	30.45	29.55	29.2	28.9	27.15	26.22	25.28	24.34	
	20	31.42	30.51	30.0	29.7	28.14	27.20	26.27	25.32	24.38	
	30	31.48	30.56	30.5	29.12	28.19	27.25	26.31	25.37	24.42	
	40	31.53	31.1	30.10	29.17	28.24	27.30	26.36	25.41	24.47	
	50	31.58	31.6	30.15	29.22	28.29	27.35	26.40	25.45	24.51	
60	0	32.4	31.12	30.20	29.27	28.34	27.40	26.45	25.50	24.55	
	10	32.9	31.17	30.26	29.32	28.39	27.44	26.49	25.54	24.59	
	20	32.15	31.22	30.31	29.37	28.44	27.49	26.54	25.59	25.3	
	30	32.20	31.28	30.36	29.42	28.49	27.54	26.58	26.3	25.8	
	40	32.26	31.33	30.41	29.47	28.54	27.58	27.3	26.8	25.12	
	50	32.31	31.38	30.46	29.52	28.59	28.3	27.8	26.12	25.16	
61	0	32.36	31.44	30.51	29.57	29.3	28.8	27.12	26.17	25.20	
	10	32.42	31.49	30.57	30.2	29.8	28.12	27.17	26.21	25.24	
	20	32.47	31.54	31.2	30.7	29.13	28.17	27.21	26.26	25.29	
	30	32.53	32.0	31.7	30.12	29.18	28.22	27.26	26.30	25.33	
	40	32.58	32.5	31.12	30.17	29.23	28.26	27.31	26.34	25.37	
	50	33.4	32.10	31.17	30.22	29.28	28.31	27.35	26.39	25.41	
62	0	33.9	32.16	31.22	30.27	29.32	28.36	27.40	26.43	25.46	

T A B L E IV.
A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.									
		66°	67°	68°	69°	70°	71°	72°	73°	74°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	M S	M S	M S	M S	M S	M S	M S	M S	M S	
53	0	21. 8	20. 18	19. 28	18. 38	17. 47	16. 56	16. 4	15. 12	14. 20	
	10	21. 12	20. 22	19. 32	18. 41	17. 50	16. 59	16. 7	15. 15	14. 23	
	20	21. 16	20. 26	19. 35	18. 45	17. 54	17. 3	16. 10	15. 18	14. 26	
	30	21. 20	20. 30	19. 39	18. 48	17. 57	17. 6	16. 13	15. 21	14. 28	
	40	21. 24	20. 34	19. 43	18. 52	18. 0	17. 9	16. 16	15. 24	14. 31	
	50	21. 28	20. 38	19. 47	18. 55	18. 4	17. 12	16. 20	15. 27	14. 34	
54	0	21. 32	20. 42	19. 51	18. 59	18. 7	17. 15	16. 23	15. 30	14. 37	
	10	21. 36	20. 46	19. 54	19. 3	18. 11	17. 19	16. 26	15. 33	14. 40	
	20	21. 40	20. 50	19. 58	19. 6	18. 14	17. 22	16. 29	15. 36	14. 42	
	30	21. 45	20. 53	20. 2	19. 10	18. 18	17. 25	16. 32	15. 38	14. 45	
	40	21. 49	20. 57	20. 6	19. 14	18. 21	17. 28	16. 35	15. 41	14. 48	
	50	21. 53	21. 1	20. 10	19. 17	18. 24	17. 32	16. 38	15. 44	14. 51	
55	0	21. 57	21. 5	20. 13	19. 21	18. 28	17. 35	16. 41	15. 47	14. 53	
	10	22. 1	21. 9	20. 17	19. 24	18. 31	17. 38	16. 44	15. 50	14. 56	
	20	22. 5	21. 13	20. 21	19. 28	18. 34	17. 41	16. 47	15. 53	14. 59	
	30	22. 9	21. 17	20. 24	19. 31	18. 38	17. 44	16. 51	15. 56	15. 1	
	40	22. 13	21. 21	20. 28	19. 35	18. 42	17. 48	16. 54	15. 59	15. 4	
	50	22. 17	21. 25	20. 32	19. 39	18. 45	17. 51	16. 57	16. 2	15. 7	
56	0	22. 21	21. 29	20. 36	19. 42	18. 49	17. 54	17. 0	16. 5	15. 10	
	10	22. 25	21. 33	20. 39	19. 46	18. 52	17. 58	17. 3	16. 8	15. 13	
	20	22. 29	21. 37	20. 43	19. 49	18. 55	18. 1	17. 6	16. 11	15. 15	
	30	22. 34	21. 40	20. 47	19. 53	18. 59	18. 4	17. 9	16. 14	15. 18	
	40	22. 38	21. 44	20. 50	19. 57	19. 2	18. 7	17. 12	16. 17	15. 21	
	50	22. 42	21. 48	20. 54	20. 0	19. 5	18. 11	17. 15	16. 20	15. 24	
57	0	22. 46	21. 52	20. 58	20. 4	19. 9	18. 14	17. 18	16. 23	15. 26	
	10	22. 50	21. 56	21. 2	20. 7	19. 12	18. 17	17. 21	16. 26	15. 29	
	20	22. 54	22. 0	21. 6	20. 11	19. 16	18. 21	17. 25	16. 29	15. 32	
	30	22. 58	22. 4	21. 9	20. 15	19. 19	18. 24	17. 28	16. 32	15. 35	
	40	23. 2	22. 8	21. 13	20. 18	19. 23	18. 27	17. 31	16. 34	15. 37	
	50	23. 6	22. 12	21. 17	20. 22	19. 26	18. 30	17. 34	16. 37	15. 40	
58	0	23. 10	22. 16	21. 21	20. 25	19. 30	18. 33	17. 37	16. 40	15. 43	
	10	23. 14	22. 20	21. 24	20. 29	19. 33	18. 37	17. 40	16. 43	15. 46	
	20	23. 18	22. 24	21. 28	20. 32	19. 36	18. 40	17. 43	16. 46	15. 49	
	30	23. 22	22. 27	21. 32	20. 36	19. 40	18. 43	17. 46	16. 49	15. 51	
	40	23. 26	22. 31	21. 35	20. 40	19. 43	18. 46	17. 49	16. 52	15. 54	
	50	23. 30	22. 35	21. 39	20. 43	19. 47	18. 50	17. 52	16. 55	15. 57	
59	0	23. 34	22. 39	21. 43	20. 47	19. 50	18. 53	17. 55	16. 58	16. 0	
	10	23. 39	22. 43	21. 47	20. 50	19. 54	18. 56	17. 59	17. 1	16. 2	
	20	23. 43	22. 47	21. 50	20. 54	19. 57	18. 59	18. 2	17. 3	16. 5	
	30	23. 47	22. 51	21. 54	20. 57	20. 1	19. 3	18. 5	17. 6	16. 8	
	40	23. 51	22. 55	21. 58	21. 1	20. 4	19. 6	18. 8	17. 9	16. 11	
	50	23. 55	22. 58	22. 2	21. 4	20. 7	19. 9	18. 11	17. 12	16. 13	
60	0	23. 59	23. 2	22. 6	21. 8	20. 11	19. 12	18. 14	17. 15	16. 16	
	10	24. 3	23. 6	22. 9	21. 12	20. 14	19. 15	18. 17	17. 18	16. 19	
	20	24. 7	23. 10	22. 13	21. 15	20. 18	19. 19	18. 20	17. 21	16. 21	
	30	24. 11	23. 14	22. 17	21. 19	20. 21	19. 22	18. 24	17. 24	16. 24	
	40	24. 15	23. 18	22. 21	21. 22	20. 24	19. 25	18. 27	17. 27	16. 27	
	50	24. 19	23. 22	22. 24	21. 26	20. 28	19. 29	18. 30	17. 30	16. 30	
61	0	24. 23	23. 26	22. 28	21. 30	20. 31	19. 32	18. 33	17. 33	16. 33	
	10	24. 27	23. 30	22. 32	21. 33	20. 35	19. 35	18. 36	17. 36	16. 35	
	20	24. 31	23. 33	22. 36	21. 37	20. 39	19. 39	18. 39	17. 39	16. 38	
	30	24. 35	23. 37	22. 39	21. 40	20. 42	19. 42	18. 42	17. 41	16. 41	
	40	24. 39	23. 41	22. 43	21. 44	20. 46	19. 45	18. 45	17. 44	16. 44	
	50	24. 44	23. 45	22. 47	21. 47	20. 49	19. 48	18. 48	17. 47	16. 46	
62	0	24. 48	23. 49	22. 51	21. 51	20. 52	19. 52	18. 51	17. 50	16. 49	

T A B L E IV.
A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.									
		75°	76°	77°	78°	79°	80°	81°	82°	83°	
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	Corr.	
M	S	MS	MS	MS	MS	MS	MS	MS	MS	MS	
53	0	13.28	12.35	11.42	10.49	9.55	9.2	8.8	7.15	6.21	
	10	13.30	12.37	11.44	10.51	9.57	9.3	8.9	7.16	6.22	
	20	13.33	12.40	11.46	10.53	9.59	9.5	8.11	7.18	6.23	
	30	13.35	12.42	11.49	10.55	10.1	9.7	8.13	7.19	6.25	
	40	13.38	12.45	11.51	10.57	10.3	9.9	8.14	7.20	6.26	
	50	13.40	12.47	11.53	10.59	10.5	9.11	8.16	7.22	6.27	
54	0	13.43	12.50	11.56	11.2	10.7	9.13	8.18	7.23	6.28	
	10	13.45	12.52	11.58	11.4	10.9	9.14	8.19	7.25	6.29	
	20	13.48	12.54	12.0	11.6	10.11	9.16	8.21	7.26	6.30	
	30	13.51	12.57	12.2	11.8	10.13	9.18	8.22	7.28	6.32	
	40	13.54	12.59	12.5	11.10	10.15	9.20	8.24	7.29	6.33	
	50	13.56	13.2	12.7	11.12	10.17	9.21	8.25	7.30	6.34	
55	0	13.59	13.4	12.9	11.14	10.19	9.23	8.27	7.31	6.35	
	10	14.1	13.7	12.12	11.16	10.20	9.25	8.29	7.33	6.36	
	20	14.4	13.9	12.14	11.18	10.22	9.26	8.30	7.34	6.38	
	30	14.6	13.11	12.16	11.21	10.24	9.28	8.31	7.36	6.39	
	40	14.9	13.14	12.19	11.23	10.26	9.30	8.33	7.37	6.40	
	50	14.11	13.16	12.21	11.25	10.28	9.32	8.35	7.39	6.41	
56	0	14.14	13.19	12.23	11.27	10.30	9.33	8.37	7.40	6.42	
	10	14.17	13.21	12.25	11.29	10.32	9.35	8.38	7.41	6.44	
	20	14.19	13.23	12.28	11.31	10.34	9.37	8.39	7.42	6.45	
	30	14.22	13.26	12.30	11.33	10.36	9.38	8.41	7.44	6.46	
	40	14.24	13.28	12.32	11.35	10.38	9.40	8.42	7.45	6.47	
	50	14.27	13.31	12.34	11.37	10.40	9.42	8.44	7.47	6.48	
57	0	14.30	13.33	12.36	11.39	10.42	9.44	8.46	7.48	6.50	
	10	14.32	13.36	12.39	11.41	10.43	9.46	8.47	7.49	6.52	
	20	14.35	13.38	12.41	11.43	10.45	9.47	8.48	7.51	6.53	
	30	14.38	13.41	12.43	11.45	10.47	9.49	8.50	7.52	6.54	
	40	14.40	13.43	12.45	11.47	10.49	9.51	8.51	7.53	6.55	
	50	14.43	13.46	12.48	11.49	10.51	9.53	8.53	7.55	6.56	
58	0	14.46	13.48	12.50	11.51	10.53	9.54	8.55	7.56	6.57	
	10	14.48	13.50	12.52	11.54	10.55	9.56	8.56	7.57	6.59	
	20	14.51	13.53	12.54	11.56	10.57	9.58	8.57	7.59	7.0	
	30	14.53	13.55	12.57	11.58	10.58	9.59	8.59	8.0	7.1	
	40	14.56	13.57	12.59	12.0	11.0	10.1	9.1	8.2	7.2	
	50	14.58	13.59	13.1	12.2	11.2	10.3	9.3	8.3	7.3	
59	0	15.1	14.2	13.3	12.4	11.4	10.5	9.5	8.5	7.4	
	10	15.4	14.5	13.5	12.6	11.6	10.6	9.6	8.6	7.6	
	20	15.6	14.7	13.8	12.8	11.8	10.8	9.8	8.7	7.7	
	30	15.9	14.10	13.10	12.10	11.10	10.10	9.9	8.9	7.8	
	40	15.12	14.12	13.12	12.12	11.12	10.11	9.11	8.10	7.9	
	50	15.14	14.15	13.14	12.14	11.14	10.13	9.12	8.12	7.10	
60	0	15.17	14.17	13.17	12.16	11.16	10.15	9.14	8.13	7.12	
	10	15.19	14.19	13.19	12.19	11.18	10.17	9.16	8.14	7.13	
	20	15.22	14.22	13.21	12.21	11.20	10.18	9.17	8.16	7.14	
	30	15.25	14.24	13.23	12.23	11.21	10.20	9.19	8.17	7.15	
	40	15.27	14.27	13.26	12.25	11.23	10.22	9.21	8.18	7.16	
	50	15.30	14.29	13.28	12.27	11.25	10.24	9.22	8.20	7.17	
61	0	15.32	14.31	13.30	12.29	11.27	10.25	9.24	8.21	7.19	
	10	15.33	14.34	13.32	12.31	11.29	10.27	9.25	8.22	7.20	
	20	15.36	14.36	13.35	12.33	11.31	10.29	9.27	8.24	7.21	
	30	15.38	14.39	13.37	12.35	11.33	10.31	9.28	8.25	7.22	
	40	15.41	14.41	13.39	12.37	11.35	10.32	9.30	8.27	7.23	
	50	15.44	14.44	13.41	12.39	11.37	10.34	9.31	8.28	7.25	
62	0	15.48	14.46	13.44	12.41	11.39	10.36	9.33	8.30	7.26	

T A B L E IV.

A TABLE of Corrections to be added to the apparent Altitude of the Moon's Centre, for reducing it to the true Altitude.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		84°	85°	86°	87°	88°	89°
		Corr.	Corr.	Corr.	Corr.	Corr.	Corr.
M	S	M S	M S	M S	M S	M S	M S
53	0	5.26	4.32	3.38	2.43	1.49	0.54
	10	5.27	4.33	3.39	2.43	1.49	0.54
	20	5.28	4.34	3.39	2.44	1.49	0.54
	30	5.29	4.35	3.40	2.45	1.50	0.55
	40	5.30	4.36	3.41	2.45	1.50	0.55
	50	5.31	4.37	3.42	2.46	1.51	0.55
54	0	5.33	4.37	3.42	2.47	1.51	0.56
	10	5.34	4.38	3.43	2.47	1.51	0.56
	20	5.35	4.39	3.44	2.48	1.52	0.56
	30	5.36	4.40	3.44	2.48	1.52	0.56
	40	5.37	4.41	3.45	2.49	1.52	0.56
	50	5.38	4.42	3.46	2.49	1.53	0.57
55	0	5.39	4.43	3.46	2.50	1.53	0.57
	10	5.40	4.44	3.47	2.50	1.54	0.57
	20	5.41	4.45	3.48	2.51	1.54	0.57
	30	5.42	4.46	3.48	2.51	1.54	0.57
	40	5.43	4.46	3.49	2.52	1.55	0.57
	50	5.44	4.47	3.50	2.52	1.55	0.58
56	0	5.45	4.48	3.50	2.53	1.55	0.58
	10	5.46	4.49	3.51	2.53	1.56	0.58
	20	5.47	4.50	3.52	2.54	1.56	0.58
	30	5.48	4.51	3.52	2.54	1.56	0.58
	40	5.49	4.52	3.53	2.55	1.57	0.58
	50	5.50	4.52	3.54	2.55	1.57	0.59
57	0	5.51	4.53	3.55	2.56	1.57	0.59
	10	5.53	4.54	3.55	2.56	1.58	0.59
	20	5.54	4.55	3.56	2.57	1.58	0.59
	30	5.55	4.56	3.57	2.57	1.58	0.59
	40	5.56	4.57	3.57	2.58	1.59	0.59
	50	5.57	4.58	3.58	2.58	1.59	0.59
58	0	5.58	4.58	3.59	2.59	1.59	1. 0
	10	5.59	4.59	3.59	2.59	2. 0	1. 0
	20	6. 0	5. 0	4. 0	3. 0	2. 0	1. 0
	30	6. 1	5. 1	4. 1	3. 1	2. 1	1. 0
	40	6. 2	5. 2	4. 1	3. 1	2. 1	1. 0
	50	6. 3	5. 3	4. 2	3. 2	2. 1	1. 0
59	0	6. 4	5. 4	4. 3	3. 2	2. 2	1. 1
	10	6. 5	5. 5	4. 3	3. 3	2. 2	1. 1
	20	6. 6	5. 5	4. 4	3. 3	2. 2	1. 1
	30	6. 7	5. 6	4. 5	3. 4	2. 3	1. 1
	40	6. 8	5. 7	4. 5	3. 4	2. 3	1. 1
	50	6. 9	5. 8	4. 6	3. 5	2. 3	1. 1
60	0	6.10	5. 9	4. 7	3. 5	2. 4	1. 2
	10	6.12	5.10	4. 7	3. 6	2. 4	1. 2
	20	6.13	5.10	4. 8	3. 6	2. 5	1. 2
	30	6.14	5.10	4. 9	3. 7	2. 5	1. 2
	40	6.15	5.12	4. 9	3. 7	2. 5	1. 2
	50	6.16	5.13	4.10	3. 8	2. 6	1. 3
61	0	6.17	5.14	4.11	3. 9	2. 6	1. 3
	10	6.18	5.15	4.11	3. 9	2. 6	1. 3
	20	6.19	5.15	4.12	3.10	2. 7	1. 3
	30	6.20	5.16	4.13	3.10	2. 7	1. 3
	40	6.21	5.17	4.13	3.11	2. 7	1. 3
	50	6.22	5.18	4.14	3.11	2. 8	1. 4
62	0	6.23	5.19	4.15	3.12	2. 8	1. 4

T A B L E IV.
 Logarithms for readily computing the true Distance of the Moon
 from the Sun or fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre					
		3°	4°	5°	6°	7°	8°
		Logarith.	Logarith.	Logarith.	Logarith.	Logarith.	Logarith.
M	S						
53	0	9.99984	9.99973	9.99961	9.99950	9.99938	9.99926
	10	9.99984	9.99973	9.99961	9.99949	9.99938	9.99926
	20	9.99984	9.99972	9.99961	9.99949	9.99937	9.99926
	30	9.99983	9.99972	9.99961	9.99949	9.99937	9.99926
	40	9.99983	9.99972	9.99960	9.99947	9.99937	9.99925
	50	9.99983	9.99972	9.99960	9.99948	9.99937	9.99925
54	0	9.99983	9.99972	9.99960	9.99948	9.99936	9.99924
	10	9.99983	9.99971	9.99960	9.99948	9.99936	9.99924
	20	9.99983	9.99971	9.99959	9.99948	9.99936	9.99924
	30	9.99983	9.99971	9.99959	9.99947	9.99935	9.99923
	40	9.99983	9.99971	9.99959	9.99947	9.99935	9.99923
	50	9.99982	9.99971	9.99959	9.99947	9.99935	9.99923
55	0	9.99982	9.99971	9.99959	9.99947	9.99934	9.99922
	10	9.99982	9.99970	9.99958	9.99946	9.99934	9.99922
	20	9.99982	9.99970	9.99958	9.99946	9.99934	9.99922
	30	9.99982	9.99970	9.99958	9.99946	9.99934	9.99922
	40	9.99982	9.99970	9.99958	9.99946	9.99933	9.99921
	50	9.99982	9.99970	9.99958	9.99945	9.99933	9.99921
56	0	9.99982	9.99969	9.99957	9.99945	9.99933	9.99921
	10	9.99981	9.99969	9.99957	9.99945	9.99933	9.99920
	20	9.99981	9.99969	9.99957	9.99945	9.99932	9.99920
	30	9.99981	9.99969	9.99957	9.99944	9.99932	9.99920
	40	9.99981	9.99969	9.99956	9.99944	9.99932	9.99919
	50	9.99981	9.99969	9.99956	9.99944	9.99931	9.99919
57	0	9.99981	9.99968	9.99956	9.99944	9.99931	9.99919
	10	9.99981	9.99968	9.99956	9.99943	9.99931	9.99918
	20	9.99980	9.99968	9.99956	9.99943	9.99931	9.99918
	30	9.99980	9.99968	9.99955	9.99943	9.99930	9.99918
	40	9.99980	9.99968	9.99955	9.99943	9.99930	9.99917
	50	9.99980	9.99968	9.99955	9.99942	9.99930	9.99917
58	0	9.99980	9.99967	9.99955	9.99942	9.99929	9.99917
	10	9.99980	9.99967	9.99955	9.99942	9.99929	9.99916
	20	9.99980	9.99967	9.99954	9.99942	9.99929	9.99916
	30	9.99979	9.99967	9.99954	9.99941	9.99929	9.99916
	40	9.99979	9.99967	9.99954	9.99941	9.99928	9.99915
	50	9.99979	9.99967	9.99954	9.99941	9.99928	9.99915
59	0	9.99979	9.99966	9.99954	9.99941	9.99928	9.99915
	10	9.99979	9.99966	9.99953	9.99940	9.99927	9.99914
	20	9.99979	9.99966	9.99953	9.99940	9.99927	9.99914
	30	9.99978	9.99966	9.99953	9.99940	9.99927	9.99914
	40	9.99978	9.99966	9.99953	9.99940	9.99927	9.99913
	50	9.99978	9.99965	9.99952	9.99939	9.99926	9.99913
60	0	9.99978	9.99965	9.99952	9.99939	9.99926	9.99913
	10	9.99978	9.99965	9.99952	9.99939	9.99926	9.99912
	20	9.99978	9.99965	9.99952	9.99939	9.99925	9.99912
	30	9.99978	9.99965	9.99952	9.99938	9.99925	9.99912
	40	9.99978	9.99965	9.99951	9.99938	9.99925	9.99911
	50	9.99977	9.99964	9.99951	9.99938	9.99924	9.99911
61	0	9.99977	9.99964	9.99951	9.99938	9.99924	9.99911
	10	9.99977	9.99964	9.99951	9.99937	9.99924	9.99910
	20	9.99977	9.99964	9.99951	9.99937	9.99924	9.99910
	30	9.99977	9.99964	9.99950	9.99937	9.99923	9.99910
	40	9.99977	9.99964	9.99950	9.99937	9.99923	9.99909
	50	9.99977	9.99963	9.99950	9.99937	9.99923	9.99909
62	0	9.99976	9.99963	9.99950	9.99936	9.99922	9.99909

T A B L E IV. Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.					
Moon's horizontal Parallax.		9°	10°	11°	12°	13°	14°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99914.8	9.99903.2	9.99891.7	9.99880.3	9.99868.8	9.99857.4
	10	9.99914.4	9.99902.8	9.99891.3	9.99879.2	9.99868.3	9.99856.9
	20	9.99914.0	9.99902.4	9.99890.8	9.99879.4	9.99867.8	9.99856.3
	30	9.99913.7	9.99902.1	9.99890.4	9.99878.9	9.99867.3	9.99855.8
	40	9.99913.3	9.99901.7	9.99890.0	9.99878.4	9.99866.8	9.99855.3
	50	9.99912.9	9.99901.3	9.99889.5	9.99877.9	9.99866.3	9.99854.7
54	0	9.99912.6	9.99900.9	9.99889.1	9.99877.4	9.99865.8	9.99854.2
	10	9.99912.2	9.99900.5	9.99888.6	9.99877.0	9.99865.3	9.99853.7
	20	9.99911.9	9.99900.1	9.99888.2	9.99876.5	9.99864.8	9.99853.1
	30	9.99911.5	9.99899.7	9.99887.8	9.99876.0	9.99864.3	9.99852.6
	40	9.99911.2	9.99899.3	9.99887.3	9.99875.6	9.99863.8	9.99852.1
	50	9.99910.8	9.99898.9	9.99886.9	9.99875.1	9.99863.3	9.99851.5
55	0	9.99910.5	9.99898.5	9.99886.5	9.99874.6	9.99862.8	9.99851.0
	10	9.99910.1	9.99898.1	9.99886.0	9.99874.2	9.99862.3	9.99850.4
	20	9.99909.8	9.99897.7	9.99885.6	9.99873.7	9.99861.8	9.99849.8
	30	9.99909.4	9.99897.3	9.99885.2	9.99873.2	9.99861.3	9.99849.3
	40	9.99909.1	9.99896.9	9.99884.7	9.99872.7	9.99860.7	9.99848.8
	50	9.99908.7	9.99896.5	9.99884.3	9.99872.2	9.99860.2	9.99848.2
56	0	9.99908.3	9.99896.1	9.99883.9	9.99871.8	9.99859.7	9.99847.7
	10	9.99907.9	9.99895.7	9.99883.4	9.99871.3	9.99859.2	9.99847.1
	20	9.99907.6	9.99895.3	9.99883.0	9.99870.8	9.99858.7	9.99846.6
	30	9.99907.2	9.99894.9	9.99882.6	9.99870.4	9.99858.2	9.99846.0
	40	9.99906.9	9.99894.5	9.99882.1	9.99869.9	9.99857.7	9.99845.5
	50	9.99906.5	9.99894.1	9.99881.7	9.99869.4	9.99857.2	9.99844.9
57	0	9.99906.2	9.99893.7	9.99881.3	9.99869.0	9.99856.7	9.99844.4
	10	9.99905.8	9.99893.4	9.99880.8	9.99868.5	9.99856.2	9.99843.9
	20	9.99905.5	9.99893.0	9.99880.4	9.99868.0	9.99855.7	9.99843.3
	30	9.99905.1	9.99892.6	9.99880.0	9.99867.6	9.99855.2	9.99842.8
	40	9.99904.8	9.99892.2	9.99879.5	9.99867.1	9.99854.6	9.99842.3
	50	9.99904.4	9.99891.8	9.99879.1	9.99866.6	9.99854.1	9.99841.8
58	0	9.99904.0	9.99891.4	9.99878.7	9.99866.2	9.99853.6	9.99841.2
	10	9.99903.7	9.99891.0	9.99878.2	9.99865.7	9.99853.1	9.99840.7
	20	9.99903.3	9.99890.6	9.99877.8	9.99865.2	9.99852.6	9.99840.1
	30	9.99902.9	9.99890.2	9.99877.4	9.99864.8	9.99852.1	9.99839.6
	40	9.99902.6	9.99889.8	9.99876.9	9.99864.3	9.99851.6	9.99839.1
	50	9.99902.2	9.99889.4	9.99876.5	9.99863.8	9.99851.1	9.99838.5
59	0	9.99901.8	9.99889.0	9.99876.1	9.99863.4	9.99850.6	9.99838.0
	10	9.99901.4	9.99888.6	9.99875.6	9.99862.9	9.99850.1	9.99837.4
	20	9.99901.1	9.99888.2	9.99875.2	9.99862.4	9.99849.6	9.99836.9
	30	9.99900.7	9.99887.8	9.99874.8	9.99861.9	9.99849.1	9.99836.3
	40	9.99900.4	9.99887.4	9.99874.3	9.99861.5	9.99848.6	9.99835.8
	50	9.99900.0	9.99887.0	9.99873.9	9.99861.0	9.99848.1	9.99835.2
60	0	9.99899.7	9.99886.6	9.99873.5	9.99860.5	9.99847.6	9.99834.7
	10	9.99899.3	9.99886.2	9.99873.0	9.99860.0	9.99847.1	9.99834.1
	20	9.99899.0	9.99885.8	9.99872.6	9.99859.6	9.99846.6	9.99833.6
	30	9.99898.6	9.99885.4	9.99872.2	9.99859.1	9.99846.1	9.99833.0
	40	9.99898.2	9.99885.0	9.99871.7	9.99858.6	9.99845.5	9.99832.5
	50	9.99897.9	9.99884.6	9.99871.3	9.99858.1	9.99845.0	9.99831.9
61	0	9.99897.5	9.99884.2	9.99870.9	9.99857.7	9.99844.5	9.99831.4
	10	9.99897.1	9.99883.8	9.99870.4	9.99857.2	9.99844.0	9.99830.8
	20	9.99896.8	9.99883.4	9.99870.0	9.99856.7	9.99843.5	9.99830.3
	30	9.99896.4	9.99883.0	9.99869.5	9.99856.2	9.99843.0	9.99829.7
	40	9.99896.0	9.99882.6	9.99869.1	9.99855.8	9.99842.5	9.99829.2
	50	9.99895.7	9.99882.2	9.99868.7	9.99855.3	9.99842.0	9.99828.6
62	0	9.99895.3	9.99881.8	9.99868.3	9.99854.8	9.99841.5	9.99828.1

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		15°	16°	17°	18°	19°	20°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99846.0	9.99834.8	9.99823.6	9.99812.4	9.99801.3	9.99790.2
	10	9.99845.4	9.99834.2	9.99823.0	9.99811.7	9.99800.6	9.99789.5
	20	9.99844.9	9.99833.6	9.99822.3	9.99811.0	9.99799.8	9.99788.7
	30	9.99844.3	9.99832.9	9.99821.7	9.99810.4	9.99799.1	9.99788.0
	40	9.99843.7	9.99832.3	9.99821.0	9.99809.7	9.99798.4	9.99787.2
	50	9.99843.2	9.99831.7	9.99820.3	9.99809.0	9.99797.7	9.99786.5
54	0	9.99842.6	9.99831.1	9.99819.7	9.99808.3	9.99797.0	9.99785.7
	10	9.99842.0	9.99830.5	9.99819.0	9.99807.6	9.99796.3	9.99785.0
	20	9.99841.4	9.99829.9	9.99818.4	9.99806.9	9.99795.5	9.99784.2
	30	9.99840.9	9.99829.3	9.99817.7	9.99806.3	9.99794.8	9.99783.5
	40	9.99840.3	9.99828.7	9.99817.1	9.99805.6	9.99794.1	9.99783.7
	50	9.99839.7	9.99828.1	9.99816.4	9.99804.9	9.99793.4	9.99782.0
55	0	9.99839.1	9.99827.5	9.99815.8	9.99804.2	9.99792.7	9.99781.2
	10	9.99838.6	9.99826.9	9.99815.1	9.99803.5	9.99792.0	9.99780.5
	20	9.99838.0	9.99826.2	9.99814.5	9.99803.8	9.99791.3	9.99779.7
	30	9.99837.4	9.99825.6	9.99813.8	9.99803.2	9.99790.5	9.99779.0
	40	9.99836.8	9.99825.0	9.99813.2	9.99801.5	9.99789.8	9.99778.2
	50	9.99836.3	9.99824.4	9.99812.5	9.99800.8	9.99789.1	9.99777.5
56	0	9.99835.7	9.99823.8	9.99811.9	9.99800.1	9.99788.4	9.99776.7
	10	9.99835.1	9.99823.2	9.99811.2	9.99799.4	9.99787.7	9.99776.0
	20	9.99834.5	9.99822.5	9.99810.6	9.99798.7	9.99786.9	9.99775.2
	30	9.99833.9	9.99821.9	9.99809.9	9.99798.1	9.99786.2	9.99774.5
	40	9.99833.4	9.99821.3	9.99809.3	9.99797.4	9.99785.5	9.99773.7
	50	9.99832.8	9.99820.7	9.99808.6	9.99796.7	9.99784.8	9.99773.0
57	0	9.99832.2	9.99820.1	9.99808.0	9.99796.0	9.99784.1	9.99772.2
	10	9.99831.6	9.99819.5	9.99807.3	9.99795.3	9.99783.4	9.99771.5
	20	9.99831.1	9.99818.9	9.99806.7	9.99794.6	9.99782.6	9.99770.7
	30	9.99830.5	9.99818.3	9.99806.0	9.99794.0	9.99781.9	9.99770.0
	40	9.99829.9	9.99817.7	9.99805.4	9.99793.3	9.99781.2	9.99769.2
	50	9.99829.4	9.99817.1	9.99804.7	9.99792.6	9.99780.5	9.99768.5
58	0	9.99828.8	9.99816.5	9.99804.1	9.99791.9	9.99779.8	9.99767.7
	10	9.99828.2	9.99815.9	9.99803.4	9.99791.2	9.99779.0	9.99767.0
	20	9.99827.6	9.99815.2	9.99802.8	9.99790.5	9.99778.3	9.99766.2
	30	9.99827.1	9.99814.6	9.99802.1	9.99789.9	9.99777.6	9.99765.5
	40	9.99826.5	9.99814.0	9.99801.5	9.99789.2	9.99776.9	9.99764.7
	50	9.99825.9	9.99812.4	9.99800.8	9.99788.5	9.99776.2	9.99764.0
59	0	9.99825.3	9.99812.8	9.99800.2	9.99787.8	9.99775.4	9.99763.2
	10	9.99824.7	9.99812.2	9.99799.5	9.99787.1	9.99774.7	9.99762.5
	20	9.99824.1	9.99811.5	9.99798.9	9.99786.4	9.99774.0	9.99761.7
	30	9.99823.5	9.99810.9	9.99798.2	9.99785.8	9.99773.3	9.99761.0
	40	9.99823.0	9.99810.3	9.99797.6	9.99785.1	9.99772.5	9.99760.2
	50	9.99822.4	9.99819.7	9.99796.9	9.99784.4	9.99771.8	9.99759.4
60	0	9.99821.8	9.99809.1	9.99796.3	9.99783.7	9.99771.1	9.99758.6
	10	9.99821.2	9.99808.5	9.99795.6	9.99783.0	9.99770.4	9.99757.9
	20	9.99820.6	9.99807.8	9.99795.0	9.99782.3	9.99769.6	9.99757.1
	30	9.99820.1	9.99807.2	9.99794.3	9.99781.7	9.99768.9	9.99756.4
	40	9.99819.5	9.99806.6	9.99793.7	9.99781.0	9.99768.2	9.99755.6
	50	9.99818.9	9.99806.0	9.99793.0	9.99780.3	9.99767.5	9.99754.9
61	0	9.99818.3	9.99805.4	9.99792.4	9.99779.6	9.99766.7	9.99754.1
	10	9.99817.7	9.99804.8	9.99791.7	9.99778.9	9.99766.0	9.99753.4
	20	9.99817.1	9.99804.1	9.99791.1	9.99778.2	9.99765.3	9.99752.6
	30	9.99816.5	9.99803.5	9.99790.4	9.99777.5	9.99764.6	9.99751.9
	40	9.99816.0	9.99802.9	9.99789.8	9.99776.8	9.99763.8	9.99751.1
	50	9.99815.4	9.99802.3	9.99789.1	9.99776.1	9.99763.1	9.99750.4
62	0	9.99814.8	9.99801.7	9.99788.5	9.99775.4	9.99762.4	9.99749.6

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		21°	22°	23°	24°	25°	26°
M	S	Logarithm	Logarithm	Logarithm	Logarithm	Logarithm	Logarithm
53	0	9.99779.2	9.99763.4	9.99757.7	9.99746.8	9.99736.3	9.99725.7
	10	9.99778.4	9.99767.7	9.99756.8	9.99745.9	9.99735.4	9.99724.7
	20	9.99777.6	9.99766.7	9.99756.0	9.99745.0	9.99734.4	9.99723.8
	30	9.99776.9	9.99765.9	9.99755.1	9.99744.2	9.99733.5	9.99722.8
	40	9.99776.1	9.99765.1	9.99754.2	9.99743.3	9.99732.6	9.99721.8
	50	9.99775.3	9.99764.3	9.99753.4	9.99742.4	9.99731.7	9.99720.9
54	0	9.99774.5	9.99763.5	9.99752.5	9.99741.5	9.99730.7	9.99719.9
	10	9.99773.7	9.99762.6	9.99751.7	9.99740.6	9.99729.8	9.99719.0
	20	9.99773.0	9.99761.8	9.99750.8	9.99740.7	9.99728.9	9.99718.0
	30	9.99772.2	9.99761.0	9.99750.0	9.99738.8	9.99728.0	9.99717.1
	40	9.99771.4	9.99760.2	9.99749.1	9.99738.0	9.99727.0	9.99716.1
	50	9.99770.6	9.99759.4	9.99748.3	9.99737.1	9.99726.1	9.99715.2
55	0	9.99769.8	9.99758.6	9.99747.4	9.99736.2	9.99725.2	9.99714.2
	10	9.99769.0	9.99757.7	9.99746.5	9.99735.3	9.99724.3	9.99713.2
	20	9.99768.3	9.99756.9	9.99745.7	9.99734.4	9.99723.3	9.99712.3
	30	9.99767.5	9.99756.1	9.99744.8	9.99733.5	9.99722.4	9.99711.3
	40	9.99766.7	9.99755.3	9.99743.9	9.99732.6	9.99721.5	9.99710.3
	50	9.99765.9	9.99754.5	9.99743.1	9.99731.8	9.99720.6	9.99709.4
56	0	9.99765.1	9.99753.7	9.99742.2	9.99730.9	9.99719.6	9.99708.4
	10	9.99764.4	9.99752.8	9.99741.3	9.99730.0	9.99718.7	9.99707.5
	20	9.99763.6	9.99752.0	9.99740.5	9.99729.1	9.99717.8	9.99706.5
	30	9.99762.8	9.99751.2	9.99739.6	9.99728.2	9.99716.9	9.99705.6
	40	9.99762.0	9.99750.4	9.99738.8	9.99727.3	9.99716.0	9.99704.6
	50	9.99761.2	9.99749.5	9.99738.0	9.99726.4	9.99715.0	9.99703.7
57	0	9.99760.4	9.99748.7	9.99737.1	9.99725.5	9.99714.1	9.99702.7
	10	9.99759.6	9.99747.9	9.99736.2	9.99724.6	9.99713.2	9.99701.8
	20	9.99758.8	9.99747.0	9.99735.4	9.99723.7	9.99712.3	9.99700.8
	30	9.99758.0	9.99746.2	9.99734.5	9.99722.8	9.99711.3	9.99699.9
	40	9.99757.2	9.99745.4	9.99733.6	9.99722.0	9.99710.4	9.99698.9
	50	9.99756.4	9.99744.5	9.99732.8	9.99721.1	9.99709.5	9.99698.0
58	0	9.99755.6	9.99743.8	9.99731.9	9.99720.2	9.99708.6	9.99697.0
	10	9.99754.9	9.99742.9	9.99731.0	9.99719.3	9.99707.6	9.99696.1
	20	9.99754.1	9.99742.1	9.99730.2	9.99718.4	9.99706.7	9.99695.1
	30	9.99753.3	9.99741.3	9.99729.3	9.99717.5	9.99705.8	9.99694.2
	40	9.99752.5	9.99740.5	9.99728.5	9.99716.6	9.99704.9	9.99693.2
	50	9.99751.7	9.99739.6	9.99727.6	9.99715.7	9.99704.0	9.99692.3
59	0	9.99750.9	9.99738.8	9.99726.8	9.99714.8	9.99703.0	9.99691.3
	10	9.99750.1	9.99738.0	9.99725.9	9.99713.9	9.99702.1	9.99690.4
	20	9.99749.3	9.99737.1	9.99725.1	9.99713.0	9.99701.2	9.99689.4
	30	9.99748.6	9.99736.3	9.99724.2	9.99712.2	9.99700.3	9.99688.4
	40	9.99747.8	9.99735.5	9.99723.4	9.99711.3	9.99699.3	9.99687.5
	50	9.99747.0	9.99734.7	9.99722.5	9.99710.4	9.99698.4	9.99686.5
60	0	9.99746.2	9.99733.9	9.99721.7	9.99709.5	9.99697.3	9.99685.5
	10	9.99745.4	9.99733.0	9.99720.8	9.99708.6	9.99696.4	9.99684.6
	20	9.99744.6	9.99732.2	9.99719.9	9.99707.7	9.99695.5	9.99683.6
	30	9.99743.8	9.99731.4	9.99719.1	9.99706.8	9.99694.7	9.99682.7
	40	9.99743.0	9.99730.6	9.99718.2	9.99706.0	9.99693.8	9.99681.7
	50	9.99742.2	9.99729.7	9.99717.4	9.99705.1	9.99692.9	9.99680.8
61	0	9.99741.4	9.99729.0	9.99716.5	9.99704.2	9.99691.9	9.99679.8
	10	9.99740.7	9.99728.1	9.99715.7	9.99703.3	9.99691.0	9.99678.8
	20	9.99739.9	9.99727.3	9.99714.8	9.99702.4	9.99690.1	9.99677.9
	30	9.99739.1	9.99726.5	9.99714.0	9.99701.5	9.99689.1	9.99676.9
	40	9.99738.3	9.99725.7	9.99713.1	9.99700.6	9.99688.2	9.99675.9
	50	9.99737.5	9.99724.8	9.99712.3	9.99699.7	9.99687.3	9.99675.0
62	0	9.99736.7	9.99724.0	9.99711.4	9.99698.8	9.99686.3	9.99674.0

T A B L E IV. Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.					
Moon's horizont l Parallax.	M	27°	28°	29°	30°	31°	32°
		Logarithm.	Logarithm	Logarithm	Logarithm.	Logarithm	Logarithm.
53	0	9.99715.2	9.99704.8	9.99694.5	9.99684.4	9.99674.3	9.99664.3
	10	9.99714.2	9.99703.8	9.99693.5	9.99683.3	9.99673.2	9.99663.2
	20	9.99713.2	9.99702.8	9.99692.4	9.99682.2	9.99672.1	9.99662.1
	30	9.99712.2	9.99701.7	9.99691.4	9.99681.2	9.99671.0	9.99661.0
	40	9.99711.2	9.99700.7	9.99690.3	9.99680.1	9.99669.0	9.99660.9
	50	9.99710.1	9.99699.7	9.99689.2	9.99679.0	9.99668.8	9.99658.6
54	0	9.99709.2	9.99698.7	9.99688.2	9.99677.9	9.99667.6	9.99657.5
	10	9.99708.3	9.99697.7	9.99687.2	9.99676.8	9.99666.5	9.99656.3
	20	9.99707.3	9.99696.6	9.99686.1	9.99675.7	9.99665.4	9.99655.2
	30	9.99706.3	9.99695.6	9.99685.1	9.99674.6	9.99664.3	9.99654.1
	40	9.99705.3	9.99694.6	9.99684.0	9.99673.5	9.99663.2	9.99653.0
	50	9.99704.3	9.99693.6	9.99683.0	9.99672.4	9.99662.1	9.99651.9
55	0	9.99703.3	9.99692.6	9.99681.9	9.99671.3	9.99660.9	9.99650.6
	10	9.99702.3	9.99691.5	9.99680.8	9.99670.3	9.99659.8	9.99649.5
	20	9.99701.4	9.99690.5	9.99679.8	9.99669.2	9.99658.7	9.99648.3
	30	9.99700.4	9.99689.5	9.99678.8	9.99668.1	9.99657.6	9.99647.2
	40	9.99699.4	9.99688.5	9.99677.7	9.99667.0	9.99656.4	9.99646.0
	50	9.99698.4	9.99687.5	9.99676.7	9.99665.9	9.99655.3	9.99644.9
56	0	9.99697.4	9.99686.4	9.99675.6	9.99664.8	9.99654.2	9.99643.7
	10	9.99696.4	9.99685.4	9.99674.6	9.99663.8	9.99653.1	9.99642.6
	20	9.99695.4	9.99684.4	9.99673.5	9.99662.7	9.99652.0	9.99641.4
	30	9.99694.5	9.99683.4	9.99672.5	9.99661.6	9.99650.8	9.99640.3
	40	9.99693.5	9.99682.4	9.99671.4	9.99660.5	9.99649.7	9.99639.1
	50	9.99692.5	9.99681.3	9.99670.4	9.99659.4	9.99648.6	9.99638.0
57	0	9.99691.5	9.99680.3	9.99669.3	9.99658.3	9.99647.5	9.99636.8
	10	9.99690.5	9.99679.3	9.99668.3	9.99657.3	9.99646.4	9.99635.7
	20	9.99689.5	9.99678.3	9.99667.2	9.99656.2	9.99645.2	9.99634.5
	30	9.99688.5	9.99677.2	9.99666.2	9.99655.1	9.99644.1	9.99633.4
	40	9.99687.6	9.99676.2	9.99665.1	9.99654.0	9.99643.0	9.99632.2
	50	9.99686.6	9.99675.2	9.99664.1	9.99652.9	9.99641.9	9.99631.1
58	0	9.99685.6	9.99674.2	9.99663.0	9.99651.8	9.99640.8	9.99629.9
	10	9.99684.6	9.99673.1	9.99662.0	9.99650.8	9.99639.6	9.99628.8
	20	9.99683.6	9.99672.1	9.99660.9	9.99649.7	9.99638.5	9.99627.6
	30	9.99682.6	9.99671.1	9.99659.8	9.99648.6	9.99637.4	9.99626.5
	40	9.99681.6	9.99670.1	9.99658.8	9.99647.5	9.99636.3	9.99625.3
	50	9.99680.6	9.99669.0	9.99657.7	9.99646.4	9.99635.2	9.99624.2
59	0	9.99679.6	9.99668.0	9.99656.6	9.99645.3	9.99634.0	9.99623.0
	10	9.99678.6	9.99667.0	9.99655.6	9.99644.2	9.99632.9	9.99621.9
	20	9.99677.6	9.99666.0	9.99654.5	9.99643.1	9.99631.8	9.99620.7
	30	9.99676.6	9.99664.9	9.99653.5	9.99642.0	9.99630.7	9.99619.6
	40	9.99675.6	9.99663.9	9.99652.4	9.99640.9	9.99629.6	9.99618.4
	50	9.99674.6	9.99662.9	9.99651.4	9.99639.8	9.99628.4	9.99617.3
60	0	9.99673.7	9.99661.9	9.99650.3	9.99638.7	9.99627.3	9.99616.1
	10	9.99672.7	9.99660.8	9.99649.3	9.99637.7	9.99626.2	9.99615.0
	20	9.99671.7	9.99659.8	9.99648.2	9.99636.6	9.99625.1	9.99613.8
	30	9.99670.7	9.99658.8	9.99647.1	9.99635.5	9.99624.0	9.99612.6
	40	9.99669.7	9.99657.8	9.99646.1	9.99634.4	9.99622.8	9.99611.5
	50	9.99668.7	9.99656.7	9.99645.0	9.99633.3	9.99621.7	9.99610.3
61	0	9.99667.7	9.99655.7	9.99643.9	9.99632.2	9.99620.6	9.99609.1
	10	9.99666.7	9.99654.7	9.99642.9	9.99631.2	9.99619.5	9.99608.0
	20	9.99665.7	9.99653.7	9.99641.8	9.99630.1	9.99618.4	9.99606.8
	30	9.99664.7	9.99652.6	9.99640.8	9.99629.0	9.99617.3	9.99605.7
	40	9.99663.7	9.99651.6	9.99639.7	9.99627.9	9.99616.1	9.99604.5
	50	9.99662.7	9.99650.6	9.99638.6	9.99626.8	9.99615.0	9.99603.4
62	0	9.99661.7	9.99649.6	9.99637.6	9.99625.7	9.99613.9	9.99602.2

T A B L E IV.
Logarithms for readily computing the true Distance of the Moon
from the Sun or a fixed Star.

Moon's horizontal Para'lax.		Apparent Altitude of the Moon's Centre					
		33°	34°	35°	36°	37°	38°
		Logarith.	Logarith.	Logarith.	Logarith.	Logarith.	Logarith.
M	S						
53	0	9.99654.5	9.99644.7	9.99635.1	9.99625.6	9.99616.2	9.99606.9
	10	9.99653.3	9.99643.5	9.99633.9	9.99624.3	9.99614.9	9.99605.6
	20	9.99652.1	9.99642.3	9.99632.6	9.99623.1	9.99613.6	9.99604.2
	30	9.99651.0	9.99641.1	9.99631.4	9.99621.8	9.99612.3	9.99602.9
	40	9.99649.8	9.99639.9	9.99630.2	9.99620.5	9.99611.0	9.99601.6
	50	9.99648.6	9.99638.6	9.99628.9	9.99619.9	9.99609.7	9.99600.3
54	0	9.99647.4	9.99637.4	9.99627.7	9.99618.5	9.99608.4	9.99598.9
	10	9.99646.2	9.99636.2	9.99626.4	9.99616.7	9.99607.1	9.99597.6
	20	9.99645.0	9.99635.0	9.99625.2	9.99615.4	9.99605.8	9.99596.3
	30	9.99643.8	9.99633.8	9.99623.9	9.99614.2	9.99604.5	9.99595.0
	40	9.99642.7	9.99632.6	9.99622.7	9.99612.9	9.99603.2	9.99593.6
	50	9.99641.5	9.99631.4	9.99621.4	9.99611.6	9.99601.9	9.99592.3
55	0	9.99640.3	9.99630.2	9.99620.2	9.99610.3	9.99600.6	9.99591.0
	10	9.99639.1	9.99628.9	9.99619.0	9.99609.1	9.99599.3	9.99589.6
	20	9.99637.9	9.99627.7	9.99617.7	9.99607.8	9.99598.0	9.99588.3
	30	9.99636.8	9.99626.5	9.99616.5	9.99606.5	9.99596.7	9.99587.0
	40	9.99635.6	9.99625.3	9.99615.3	9.99605.2	9.99595.4	9.99585.6
	50	9.99634.4	9.99624.1	9.99614.0	9.99604.0	9.99594.1	9.99584.3
56	0	9.99633.2	9.99622.9	9.99612.8	9.99602.7	9.99592.8	9.99583.0
	10	9.99632.1	9.99621.7	9.99611.5	9.99601.4	9.99591.5	9.99581.6
	20	9.99630.9	9.99620.5	9.99610.3	9.99600.2	9.99590.2	9.99580.3
	30	9.99629.7	9.99619.3	9.99609.0	9.99598.9	9.99588.9	9.99579.0
	40	9.99628.5	9.99618.1	9.99607.8	9.99597.6	9.99587.6	9.99577.6
	50	9.99627.3	9.99616.9	9.99606.5	9.99596.3	9.99586.3	9.99576.3
57	0	9.99626.1	9.99615.7	9.99605.3	9.99595.1	9.99585.0	9.99575.0
	10	9.99625.0	9.99614.4	9.99604.1	9.99593.8	9.99583.7	9.99573.6
	20	9.99623.8	9.99613.2	9.99602.8	9.99592.6	9.99582.4	9.99572.3
	30	9.99622.6	9.99612.0	9.99601.6	9.99591.3	9.99581.1	9.99571.0
	40	9.99621.4	9.99610.8	9.99600.3	9.99590.0	9.99579.8	9.99568.6
	50	9.99620.3	9.99609.6	9.99599.1	9.99588.7	9.99578.5	9.99567.3
58	0	9.99619.1	9.99608.4	9.99597.9	9.99587.5	9.99577.2	9.99567.0
	10	9.99617.9	9.99607.2	9.99596.6	9.99586.2	9.99575.9	9.99565.6
	20	9.99616.7	9.99606.0	9.99595.4	9.99584.9	9.99574.6	9.99564.3
	30	9.99615.5	9.99604.7	9.99594.1	9.99583.6	9.99573.3	9.99563.0
	40	9.99614.4	9.99603.5	9.99592.9	9.99582.4	9.99572.0	9.99561.6
	50	9.99613.1	9.99602.3	9.99591.6	9.99581.1	9.99570.7	9.99560.3
59	0	9.99612.0	9.99601.1	9.99590.4	9.99579.8	9.99569.4	9.99559.0
	10	9.99610.8	9.99599.9	9.99589.2	9.99578.5	9.99568.0	9.99557.6
	20	9.99609.6	9.99598.7	9.99587.9	9.99577.3	9.99566.7	9.99556.3
	30	9.99608.5	9.99597.5	9.99586.7	9.99576.0	9.99565.4	9.99555.0
	40	9.99607.3	9.99596.3	9.99585.5	9.99574.7	9.99564.1	9.99553.6
	50	9.99606.2	9.99595.1	9.99584.2	9.99573.5	9.99562.8	9.99552.3
60	0	9.99604.9	9.99593.9	9.99583.0	9.99572.2	9.99561.5	9.99551.0
	10	9.99603.7	9.99592.6	9.99581.7	9.99570.9	9.99560.2	9.99549.6
	20	9.99602.5	9.99591.4	9.99580.5	9.99569.6	9.99558.9	9.99548.3
	30	9.99601.4	9.99590.2	9.99579.2	9.99568.4	9.99557.6	9.99547.0
	40	9.99600.2	9.99589.0	9.99578.0	9.99567.1	9.99556.3	9.99545.6
	50	9.99599.0	9.99587.8	9.99576.7	9.99565.8	9.99555.0	9.99544.3
61	0	9.99597.8	9.99586.6	9.99575.5	9.99564.5	9.99553.7	9.99543.0
	10	9.99596.6	9.99585.3	9.99574.2	9.99563.3	9.99552.4	9.99541.6
	20	9.99595.4	9.99584.1	9.99573.0	9.99562.0	9.99551.1	9.99540.3
	30	9.99594.3	9.99582.9	9.99571.7	9.99560.7	9.99549.8	9.99539.0
	40	9.99593.1	9.99581.7	9.99570.5	9.99559.4	9.99548.5	9.99537.6
	50	9.99591.9	9.99580.5	9.99569.2	9.99558.2	9.99547.2	9.99536.3
62	0	9.99590.7	9.99579.3	9.99568.0	9.99556.9	9.99545.9	9.99535.0

T A B L E IV. Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.					
Moon's Horizontal Parallax.		39°	40°	41°	42°	43°	44°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99527.7	9.99588.7	9.99579.8	9.99571.1	9.99562.5	9.99554.0
	10	9.99526.4	9.99587.3	9.99578.4	9.99569.7	9.99561.0	9.99552.5
	20	9.99525.0	9.99585.9	9.99577.0	9.99568.2	9.99559.5	9.99551.0
	30	9.99523.7	9.99584.6	9.99575.6	9.99566.8	9.99558.1	9.99549.5
	40	9.99522.3	9.99583.2	9.99574.1	9.99565.3	9.99556.6	9.99548.0
	50	9.99521.0	9.99581.8	9.99572.7	9.99563.9	9.99555.1	9.99546.5
54	0	9.99589.6	9.99580.4	9.99571.3	9.99562.4	9.99553.6	9.99545.0
	10	9.99588.3	9.99579.0	9.99569.9	9.99561.0	9.99552.2	9.99543.5
	20	9.99586.9	9.99577.6	9.99568.5	9.99559.6	9.99550.7	9.99542.0
	30	9.99585.6	9.99576.2	9.99567.1	9.99558.1	9.99549.2	9.99540.5
	40	9.99584.2	9.99574.8	9.99565.7	9.99556.7	9.99547.8	9.99539.0
	50	9.99582.9	9.99573.5	9.99564.3	9.99555.2	9.99546.3	9.99537.5
55	0	9.99581.5	9.99572.1	9.99562.8	9.99553.8	9.99544.8	9.99536.0
	10	9.99580.1	9.99570.7	9.99561.4	9.99552.3	9.99543.4	9.99534.5
	20	9.99578.8	9.99569.3	9.99560.0	9.99550.9	9.99541.9	9.99533.1
	30	9.99577.4	9.99567.9	9.99558.6	9.99549.4	9.99540.4	9.99531.6
	40	9.99576.1	9.99566.5	9.99557.2	9.99548.0	9.99539.0	9.99530.1
	50	9.99574.7	9.99565.2	9.99555.8	9.99546.5	9.99537.5	9.99528.6
56	0	9.99573.3	9.99563.8	9.99554.4	9.99545.1	9.99536.0	9.99527.1
	10	9.99572.0	9.99562.4	9.99552.9	9.99543.7	9.99534.6	9.99525.6
	20	9.99570.6	9.99561.0	9.99551.5	9.99542.2	9.99533.1	9.99524.1
	30	9.99569.3	9.99559.6	9.99550.1	9.99540.8	9.99531.6	9.99522.6
	40	9.99567.9	9.99558.2	9.99548.7	9.99539.4	9.99530.2	9.99521.1
	50	9.99566.6	9.99556.8	9.99547.3	9.99537.9	9.99528.7	9.99519.5
57	0	9.99565.2	9.99555.4	9.99545.9	9.99536.5	9.99527.2	9.99518.1
	10	9.99563.8	9.99554.1	9.99544.4	9.99535.0	9.99525.8	9.99516.6
	20	9.99562.5	9.99552.7	9.99543.0	9.99533.6	9.99524.3	9.99515.1
	30	9.99561.1	9.99551.3	9.99541.6	9.99532.1	9.99522.8	9.99513.6
	40	9.99559.7	9.99549.9	9.99540.2	9.99530.7	9.99521.4	9.99512.1
	50	9.99558.4	9.99548.5	9.99538.8	9.99529.2	9.99519.9	9.99510.6
58	0	9.99557.0	9.99547.1	9.99537.4	9.99527.8	9.99518.4	9.99509.1
	10	9.99555.6	9.99545.7	9.99535.9	9.99526.3	9.99516.9	9.99507.6
	20	9.99554.3	9.99544.3	9.99534.5	9.99524.9	9.99515.5	9.99506.1
	30	9.99552.9	9.99542.9	9.99533.1	9.99523.4	9.99514.0	9.99504.6
	40	9.99551.6	9.99541.6	9.99531.7	9.99522.0	9.99512.5	9.99503.1
	50	9.99550.2	9.99540.2	9.99530.3	9.99520.5	9.99511.0	9.99501.6
59	0	9.99548.8	9.99538.8	9.99528.9	9.99519.1	9.99509.5	9.99500.1
	10	9.99547.5	9.99537.4	9.99527.4	9.99517.7	9.99508.1	9.99498.6
	20	9.99546.1	9.99536.0	9.99526.0	9.99516.3	9.99506.6	9.99497.1
	30	9.99544.7	9.99534.6	9.99524.6	9.99514.8	9.99505.1	9.99495.6
	40	9.99543.4	9.99533.2	9.99523.2	9.99513.4	9.99503.7	9.99494.1
	50	9.99542.0	9.99531.8	9.99521.8	9.99511.9	9.99502.2	9.99492.6
60	0	9.99540.7	9.99530.4	9.99520.4	9.99510.5	9.99500.7	9.99491.1
	10	9.99539.3	9.99529.1	9.99518.9	9.99509.0	9.99499.3	9.99489.6
	20	9.99537.9	9.99527.7	9.99517.5	9.99507.6	9.99497.8	9.99488.1
	30	9.99536.6	9.99526.3	9.99516.1	9.99506.1	9.99496.3	9.99486.6
	40	9.99535.2	9.99524.9	9.99514.7	9.99504.7	9.99494.9	9.99485.1
	50	9.99533.8	9.99523.5	9.99513.3	9.99503.2	9.99493.4	9.99483.6
61	0	9.99532.5	9.99522.1	9.99511.9	9.99501.8	9.99491.9	9.99482.1
	10	9.99531.1	9.99520.7	9.99510.4	9.99500.3	9.99490.4	9.99480.6
	20	9.99529.7	9.99519.3	9.99509.0	9.99498.9	9.99489.0	9.99479.1
	30	9.99528.4	9.99518.0	9.99507.6	9.99497.4	9.99487.5	9.99477.5
	40	9.99527.0	9.99516.6	9.99506.2	9.99496.0	9.99486.0	9.99476.1
	50	9.99525.6	9.99515.2	9.99504.8	9.99494.5	9.99484.5	9.99474.6
62	0	9.99524.3	9.99513.8	9.99503.3	9.99493.1	9.99483.0	9.99473.1

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		45°	46°	47°	48°	49°	50°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99545.6	9.99537.4	9.99529.4	9.99521.5	9.99513.7	9.99506.1
	10	9.99544.7	9.99535.9	9.99527.9	9.99519.9	9.99512.1	9.99504.5
	20	9.99542.6	9.99534.4	9.99526.3	9.99518.3	9.99510.5	9.99502.8
	30	9.99541.0	9.99532.8	9.99524.7	9.99516.7	9.99508.9	9.99501.2
	40	9.99539.5	9.99531.3	9.99523.1	9.99515.1	9.99507.2	9.99499.5
	50	9.99538.0	9.99529.8	9.99521.6	9.99513.5	9.99505.6	9.99497.9
54	0	9.99536.5	9.99528.2	9.99520.0	9.99511.9	9.99504.0	9.99496.2
	10	9.99535.0	9.99526.7	9.99518.4	9.99510.3	9.99502.4	9.99494.6
	20	9.99533.4	9.99525.1	9.99516.8	9.99508.7	9.99500.8	9.99493.0
	30	9.99531.9	9.99523.6	9.99515.3	9.99507.1	9.99499.1	9.99491.3
	40	9.99530.4	9.99522.0	9.99513.7	9.99505.5	9.99497.5	9.99489.7
	50	9.99528.9	9.99520.5	9.99512.1	9.99503.9	9.99495.9	9.99488.0
55	0	9.99527.4	9.99518.9	9.99510.5	9.99502.3	9.99494.3	9.99486.4
	10	9.99525.8	9.99517.4	9.99508.9	9.99500.7	9.99492.6	9.99484.7
	20	9.99524.3	9.99515.8	9.99507.4	9.99499.1	9.99491.0	9.99483.1
	30	9.99522.8	9.99514.3	9.99505.8	9.99497.5	9.99489.4	9.99481.4
	40	9.99521.3	9.99512.7	9.99504.2	9.99495.9	9.99487.8	9.99479.8
	50	9.99519.7	9.99511.2	9.99502.6	9.99494.3	9.99486.1	9.99478.1
56	0	9.99518.2	9.99509.6	9.99501.1	9.99492.7	9.99484.5	9.99476.5
	10	9.99516.7	9.99508.0	9.99499.5	9.99491.1	9.99482.9	9.99474.8
	20	9.99515.2	9.99506.5	9.99497.9	9.99489.5	9.99481.3	9.99473.2
	30	9.99513.6	9.99504.9	9.99496.4	9.99487.9	9.99479.6	9.99471.5
	40	9.99512.1	9.99503.4	9.99494.8	9.99486.3	9.99478.0	9.99469.9
	50	9.99510.6	9.99501.8	9.99493.2	9.99484.7	9.99476.4	9.99468.2
57	0	9.99509.1	9.99500.3	9.99491.6	9.99483.1	9.99474.8	9.99466.6
	10	9.99507.6	9.99498.7	9.99490.1	9.99481.5	9.99473.1	9.99464.9
	20	9.99506.0	9.99497.2	9.99488.5	9.99479.9	9.99471.5	9.99463.2
	30	9.99504.5	9.99495.6	9.99486.9	9.99478.3	9.99469.9	9.99461.6
	40	9.99503.0	9.99494.1	9.99485.3	9.99476.7	9.99468.3	9.99460.0
	50	9.99501.5	9.99492.5	9.99483.7	9.99475.1	9.99466.6	9.99458.3
58	0	9.99500.0	9.99491.0	9.99482.2	9.99473.5	9.99465.0	9.99456.7
	10	9.99498.4	9.99489.4	9.99480.6	9.99471.9	9.99463.4	9.99455.0
	20	9.99496.9	9.99487.9	9.99479.0	9.99470.3	9.99461.8	9.99453.4
	30	9.99495.4	9.99486.3	9.99477.5	9.99468.7	9.99460.1	9.99451.7
	40	9.99493.9	9.99484.8	9.99475.9	9.99467.1	9.99458.5	9.99450.1
	50	9.99492.2	9.99483.2	9.99474.3	9.99465.5	9.99456.9	9.99448.4
59	0	9.99490.8	9.99481.7	9.99472.7	9.99463.9	9.99455.3	9.99446.8
	10	9.99489.3	9.99480.1	9.99471.2	9.99462.3	9.99453.6	9.99445.1
	20	9.99487.8	9.99478.6	9.99469.6	9.99460.7	9.99452.0	9.99443.5
	30	9.99486.2	9.99477.0	9.99468.0	9.99459.1	9.99450.4	9.99441.8
	40	9.99484.7	9.99475.5	9.99466.5	9.99457.5	9.99448.8	9.99440.2
	50	9.99483.2	9.99473.9	9.99464.9	9.99455.9	9.99447.2	9.99438.5
60	0	9.99481.7	9.99472.4	9.99463.3	9.99454.3	9.99445.5	9.99436.9
	10	9.99480.1	9.99470.8	9.99461.7	9.99452.7	9.99443.9	9.99435.2
	20	9.99478.6	9.99469.3	9.99460.1	9.99451.1	9.99442.3	9.99433.6
	30	9.99477.1	9.99467.7	9.99458.6	9.99449.5	9.99440.7	9.99431.9
	40	9.99475.6	9.99466.2	9.99457.0	9.99447.9	9.99439.0	9.99430.3
	50	9.99474.0	9.99464.6	9.99455.4	9.99446.3	9.99437.4	9.99428.6
61	0	9.99472.5	9.99463.1	9.99453.8	9.99444.7	9.99435.8	9.99427.0
	10	9.99471.0	9.99461.5	9.99452.3	9.99443.1	9.99434.2	9.99425.3
	20	9.99469.5	9.99460.0	9.99450.7	9.99441.5	9.99432.5	9.99423.7
	30	9.99467.9	9.99458.4	9.99449.1	9.99439.9	9.99430.9	9.99422.0
	40	9.99466.4	9.99456.9	9.99447.6	9.99438.3	9.99429.3	9.99420.4
	50	9.99464.9	9.99455.3	9.99446.0	9.99436.7	9.99427.7	9.99418.7
62	0	9.99463.4	9.99453.8	9.99444.4	9.99435.1	9.99426.0	9.99417.1

T A B L E IV. Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.					
Moon's horizontal Parallax.		51°	52°	53°	54°	55°	56°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99498.6	9.99491.3	9.99484.2	9.99477.3	9.99471.5	9.99463.9
	10	9.99496.9	9.99489.6	9.99482.5	9.99475.6	9.99468.7	9.99462.1
	20	9.99495.2	9.99487.9	9.99480.8	9.99473.8	9.99467.0	9.99460.2
	30	9.99493.6	9.99486.2	9.99479.1	9.99472.1	9.99465.2	9.99458.6
	40	9.99491.9	9.99484.6	9.99477.4	9.99470.3	9.99463.5	9.99456.8
	50	9.99490.2	9.99482.9	9.99475.7	9.99468.6	9.99461.7	9.99455.0
54	0	9.99488.6	9.99481.2	9.99473.9	9.99466.8	9.99459.9	9.99453.2
	10	9.99486.9	9.99479.5	9.99472.2	9.99465.1	9.99458.2	9.99451.4
	20	9.99485.2	9.99477.8	9.99470.5	9.99463.4	9.99456.4	9.99449.6
	30	9.99483.6	9.99476.1	9.99468.8	9.99461.6	9.99454.7	9.99447.9
	40	9.99481.9	9.99474.4	9.99467.1	9.99459.9	9.99452.9	9.99446.1
	50	9.99480.2	9.99472.7	9.99465.4	9.99458.2	9.99451.2	9.99444.3
55	0	9.99478.6	9.99471.0	9.99463.7	9.99456.4	9.99449.4	9.99442.5
	10	9.99476.9	9.99469.3	9.99461.9	9.99454.7	9.99447.6	9.99440.8
	20	9.99475.2	9.99467.6	9.99460.2	9.99453.0	9.99445.9	9.99439.0
	30	9.99473.6	9.99466.0	9.99458.5	9.99451.2	9.99444.1	9.99437.2
	40	9.99471.9	9.99464.3	9.99456.8	9.99449.5	9.99442.3	9.99435.4
	50	9.99470.2	9.99462.6	9.99455.1	9.99447.8	9.99440.6	9.99433.7
56	0	9.99468.6	9.99460.9	9.99453.4	9.99446.0	9.99438.8	9.99431.9
	10	9.99466.9	9.99459.2	9.99451.6	9.99444.3	9.99437.1	9.99430.1
	20	9.99465.2	9.99457.5	9.99449.9	9.99442.5	9.99435.3	9.99428.3
	30	9.99463.6	9.99455.8	9.99448.2	9.99440.8	9.99433.6	9.99426.5
	40	9.99461.9	9.99454.1	9.99446.5	9.99439.1	9.99431.8	9.99424.7
	50	9.99460.2	9.99452.4	9.99444.8	9.99437.3	9.99430.1	9.99423.0
57	0	9.99458.6	9.99450.7	9.99443.1	9.99435.6	9.99428.3	9.99421.2
	10	9.99456.9	9.99449.0	9.99441.4	9.99433.9	9.99426.5	9.99419.4
	20	9.99455.2	9.99447.3	9.99439.6	9.99432.1	9.99424.8	9.99417.6
	30	9.99453.6	9.99445.7	9.99437.9	9.99430.4	9.99423.0	9.99415.8
	40	9.99451.9	9.99444.0	9.99436.2	9.99428.7	9.99421.3	9.99414.0
	50	9.99450.2	9.99442.3	9.99434.5	9.99426.9	9.99419.5	9.99412.3
58	0	9.99448.6	9.99440.6	9.99432.8	9.99425.2	9.99417.7	9.99410.5
	10	9.99446.9	9.99438.9	9.99431.1	9.99423.4	9.99416.0	9.99408.7
	20	9.99445.2	9.99437.2	9.99429.4	9.99421.7	9.99414.2	9.99406.9
	30	9.99443.6	9.99435.5	9.99427.6	9.99420.0	9.99412.5	9.99405.1
	40	9.99441.9	9.99433.8	9.99425.9	9.99418.2	9.99410.7	9.99403.3
	50	9.99440.2	9.99432.1	9.99424.2	9.99416.5	9.99409.0	9.99401.6
59	0	9.99438.5	9.99430.4	9.99422.5	9.99414.7	9.99407.2	9.99399.8
	10	9.99436.9	9.99428.7	9.99420.8	9.99413.0	9.99405.4	9.99398.0
	20	9.99435.2	9.99427.0	9.99419.1	9.99411.2	9.99403.7	9.99396.2
	30	9.99433.5	9.99425.3	9.99417.4	9.99409.5	9.99401.9	9.99394.4
	40	9.99431.9	9.99423.6	9.99415.6	9.99407.8	9.99400.2	9.99392.7
	50	9.99430.2	9.99421.9	9.99413.9	9.99406.0	9.99398.4	9.99390.9
60	0	9.99428.5	9.99420.2	9.99412.2	9.99404.3	9.99396.6	9.99389.1
	10	9.99426.9	9.99418.5	9.99410.5	9.99402.6	9.99394.9	9.99387.3
	20	9.99425.2	9.99416.8	9.99408.8	9.99400.8	9.99393.1	9.99385.5
	30	9.99423.5	9.99415.2	9.99407.1	9.99399.1	9.99391.3	9.99383.7
	40	9.99421.9	9.99413.5	9.99405.4	9.99397.4	9.99389.6	9.99382.0
	50	9.99420.2	9.99411.8	9.99403.6	9.99395.6	9.99387.8	9.99380.2
61	0	9.99418.5	9.99410.1	9.99401.9	9.99393.9	9.99386.0	9.99378.4
	10	9.99416.8	9.99408.4	9.99400.2	9.99392.1	9.99384.3	9.99376.6
	20	9.99415.2	9.99406.7	9.99398.5	9.99390.4	9.99382.5	9.99374.8
	30	9.99413.5	9.99405.0	9.99396.8	9.99388.6	9.99380.8	9.99373.1
	40	9.99411.8	9.99403.3	9.99395.1	9.99386.9	9.99379.0	9.99371.3
	50	9.99410.1	9.99401.6	9.99393.4	9.99385.1	9.99377.3	9.99369.5
62	0	9.99408.4	9.99399.9	9.99391.6	9.99383.4	9.99375.5	9.99367.7

T A B L E IV.
Logarithms for computing the true Distance of the Moon from
the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.					
Moon's horizontal Parallax.		57°	58°	59°	60°	61°	62°
M	D.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99457.4	9.99451.2	9.99445.1	9.99439.2	9.99433.5	9.95427.9
	10	9.99455.6	9.99449.4	9.99443.2	9.99437.4	9.99431.6	9.99426.0
	20	9.99453.8	9.99447.6	9.99441.4	9.99435.5	9.99429.7	9.99424.1
	30	9.99452.0	9.99445.8	9.99439.6	9.99433.7	9.99427.9	9.99422.2
	40	9.99450.2	9.99443.9	9.99437.7	9.99431.8	9.99426.0	9.99420.3
	50	9.99448.4	9.99442.1	9.99435.9	9.99430.0	9.99424.1	9.99418.4
54	0	9.99446.6	9.99440.3	9.99434.1	9.99428.1	9.99422.2	9.99416.5
	10	9.99444.8	9.99438.5	9.99432.2	9.99426.3	9.99420.4	9.99414.6
	20	9.99443.0	9.99436.6	9.99430.4	9.99424.4	9.99418.5	9.99412.7
	30	9.99441.2	9.99434.8	9.99428.5	9.99422.5	9.99416.6	9.99410.9
	40	9.99439.4	9.99433.0	9.99426.7	9.99420.7	9.99414.7	9.99409.0
	50	9.99437.6	9.99431.2	9.99424.9	9.99418.8	9.99412.9	9.99407.1
55	0	9.99435.8	9.99429.4	9.99423.0	9.99416.9	9.99411.0	9.99405.5
	10	9.99434.0	9.99427.5	9.99421.2	9.99415.1	9.99409.1	9.99403.3
	20	9.99432.2	9.99425.7	9.99419.4	9.99413.2	9.99407.2	9.99401.4
	30	9.99430.4	9.99423.9	9.99417.5	9.99411.4	9.99405.4	9.99399.5
	40	9.99428.6	9.99422.1	9.99415.7	9.99409.5	9.99403.5	9.99397.6
	50	9.99426.8	9.99420.3	9.99413.9	9.99407.7	9.99401.6	9.99395.7
56	0	9.99425.0	9.99418.4	9.99412.0	9.99405.8	9.99409.7	9.99393.8
	10	9.99423.2	9.99416.6	9.99410.2	9.99403.9	9.99407.8	9.99391.9
	20	9.99421.4	9.99414.8	9.99408.3	9.99402.1	9.99405.9	9.99390.0
	30	9.99419.6	9.99413.0	9.99406.5	9.99400.2	9.99404.0	9.99388.1
	40	9.99417.8	9.99411.2	9.99404.6	9.99398.4	9.99402.2	9.99386.3
	50	9.99416.0	9.99409.3	9.99402.8	9.99396.5	9.99400.3	9.99384.4
57	0	9.99414.2	9.99407.5	9.99400.9	9.99394.6	9.99388.5	9.99382.5
	10	9.99412.4	9.99405.7	9.99399.1	9.99392.8	9.99386.6	9.99380.6
	20	9.99410.6	9.99403.9	9.99397.3	9.99390.9	9.99384.7	9.99378.7
	30	9.99408.8	9.99402.1	9.99395.4	9.99389.1	9.99382.8	9.99376.8
	40	9.99407.0	9.99400.2	9.99393.6	9.99387.2	9.99381.0	9.99374.9
	50	9.99405.2	9.99398.4	9.99391.8	9.99385.4	9.99379.1	9.99373.0
58	0	9.99403.4	9.99396.6	9.99389.9	9.99383.5	9.99377.2	9.99371.1
	10	9.99401.6	9.99394.8	9.99388.1	9.99381.6	9.99375.3	9.99369.2
	20	9.99399.8	9.99393.0	9.99386.3	9.99379.8	9.99373.5	9.99367.3
	30	9.99398.0	9.99391.1	9.99384.4	9.99377.9	9.99371.6	9.99365.4
	40	9.99396.2	9.99389.3	9.99382.6	9.99376.0	9.99369.7	9.99363.5
	50	9.99394.4	9.99387.5	9.99380.8	9.99374.2	9.99367.8	9.99361.6
59	0	9.99392.6	9.99385.7	9.99378.9	9.99372.5	9.99366.0	9.99359.7
	10	9.99390.8	9.99383.9	9.99377.1	9.99370.5	9.99364.1	9.99357.9
	20	9.99389.0	9.99382.0	9.99375.3	9.99368.6	9.99362.2	9.99356.0
	30	9.99387.2	9.99380.2	9.99373.4	9.99366.8	9.99360.3	9.99354.1
	40	9.99385.4	9.99378.4	9.99371.6	9.99364.9	9.99358.4	9.99352.2
	50	9.99383.6	9.99376.6	9.99369.7	9.99363.0	9.99356.6	9.99350.3
60	0	9.99381.8	9.99374.8	9.99367.9	9.99361.2	9.99354.7	9.99348.4
	10	9.99380.0	9.99372.9	9.99366.0	9.99359.3	9.99352.8	9.99346.5
	20	9.99378.2	9.99371.1	9.99364.2	9.99357.4	9.99350.9	9.99344.6
	30	9.99376.4	9.99369.3	9.99362.3	9.99355.6	9.99349.0	9.99342.7
	40	9.99374.6	9.99367.5	9.99360.5	9.99353.7	9.99347.2	9.99340.8
	50	9.99372.8	9.99365.7	9.99358.7	9.99351.8	9.99345.3	9.99338.9
61	0	9.99371.0	9.99363.8	9.99356.8	9.99350.0	9.99343.4	9.99337.0
	10	9.99369.2	9.99362.0	9.99355.0	9.99348.1	9.99341.5	9.99335.1
	20	9.99367.4	9.99360.2	9.99353.2	9.99346.2	9.99339.6	9.99333.2
	30	9.99365.6	9.99358.4	9.99351.3	9.99344.4	9.99337.8	9.99331.3
	40	9.99363.8	9.99356.6	9.99349.5	9.99342.5	9.99335.9	9.99329.4
	50	9.99362.0	9.99354.8	9.99347.7	9.99340.6	9.99334.0	9.99327.5
62	0	9.99360.2	9.99352.9	9.99345.8	9.99338.8	9.99332.1	9.99325.6

T A B L E IV.
Logarithms for readily computing the true Distance of the Moon
from the Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		63°	64°	65°	66°	67°	68°
M	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99422.4	9.99417.2	9.99412.1	9.99407.5	9.99402.7	9.99398.2
	10	9.99420.5	9.99415.3	9.99410.2	9.99405.3	9.99400.7	9.99396.2
	20	9.99418.6	9.99413.4	9.99408.3	9.99403.4	9.99398.7	9.99394.2
	30	9.99416.7	9.99411.4	9.99406.3	9.99401.4	9.99396.8	9.99392.2
	40	9.99414.8	9.99409.5	9.99404.4	9.99399.5	9.99394.8	9.99390.2
	50	9.99412.9	9.99407.6	9.99402.5	9.99397.5	9.99392.8	9.99388.2
54	0	9.99411.0	9.99405.7	9.99400.5	9.99395.6	9.99390.8	9.99386.2
	10	9.99409.1	9.99403.8	9.99398.6	9.99393.6	9.99388.9	9.99384.3
	20	9.99407.2	9.99401.8	9.99396.6	9.99391.7	9.99386.9	9.99382.3
	30	9.99405.3	9.99399.9	9.99394.7	9.99389.7	9.99384.9	9.99380.3
	40	9.99403.4	9.99398.0	9.99392.8	9.99387.7	9.99382.9	9.99378.3
	50	9.99401.5	9.99396.1	9.99390.8	9.99385.8	9.99380.9	9.99376.3
55	0	9.99399.6	9.99393.3	9.99388.8	9.99383.8	9.99379.0	9.99374.3
	10	9.99397.7	9.99391.4	9.99386.9	9.99381.9	9.99377.0	9.99372.4
	20	9.99395.7	9.99389.5	9.99385.0	9.99379.9	9.99375.1	9.99370.4
	30	9.99393.8	9.99387.4	9.99383.0	9.99378.0	9.99373.1	9.99368.4
	40	9.99391.9	9.99385.4	9.99381.1	9.99376.0	9.99371.1	9.99366.4
	50	9.99390.0	9.99383.5	9.99379.1	9.99374.0	9.99369.2	9.99364.4
56	0	9.99388.1	9.99381.6	9.99377.2	9.99372.1	9.99367.2	9.99362.4
	10	9.99386.2	9.99379.7	9.99375.3	9.99370.1	9.99365.2	9.99360.5
	20	9.99384.3	9.99377.7	9.99373.3	9.99368.2	9.99363.2	9.99358.5
	30	9.99382.4	9.99375.8	9.99371.4	9.99366.2	9.99361.3	9.99356.5
	40	9.99380.5	9.99373.9	9.99369.5	9.99364.2	9.99359.3	9.99354.5
	50	9.99378.6	9.99372.0	9.99367.5	9.99362.3	9.99357.3	9.99352.5
57	0	9.99376.6	9.99370.0	9.99365.6	9.99360.3	9.99355.3	9.99350.5
	10	9.99374.7	9.99368.1	9.99363.6	9.99358.4	9.99353.4	9.99348.6
	20	9.99372.8	9.99366.2	9.99361.7	9.99356.4	9.99351.4	9.99346.6
	30	9.99370.9	9.99364.2	9.99359.8	9.99354.5	9.99349.4	9.99344.6
	40	9.99369.0	9.99362.3	9.99357.8	9.99352.5	9.99347.4	9.99342.6
	50	9.99367.1	9.99360.4	9.99355.9	9.99350.5	9.99345.5	9.99340.6
58	0	9.99365.2	9.99358.4	9.99353.9	9.99348.6	9.99343.5	9.99338.6
	10	9.99363.2	9.99356.5	9.99352.0	9.99346.6	9.99341.5	9.99336.6
	20	9.99361.3	9.99354.6	9.99350.0	9.99344.7	9.99339.6	9.99334.6
	30	9.99359.4	9.99352.7	9.99348.1	9.99342.7	9.99337.6	9.99332.7
	40	9.99357.5	9.99350.7	9.99346.1	9.99340.7	9.99335.6	9.99330.7
	50	9.99355.6	9.99348.8	9.99344.2	9.99338.8	9.99333.6	9.99328.7
59	0	9.99353.7	9.99347.9	9.99342.2	9.99336.8	9.99331.7	9.99326.7
	10	9.99351.8	9.99345.9	9.99340.3	9.99334.9	9.99329.7	9.99324.7
	20	9.99349.8	9.99344.0	9.99338.4	9.99332.9	9.99327.7	9.99322.7
	30	9.99347.9	9.99342.1	9.99336.4	9.99331.0	9.99325.8	9.99320.7
	40	9.99346.0	9.99340.2	9.99334.5	9.99329.0	9.99323.8	9.99318.7
	50	9.99344.1	9.99338.2	9.99332.5	9.99327.0	9.99321.8	9.99316.7
60	0	9.99342.2	9.99336.3	9.99330.6	9.99325.1	9.99319.8	9.99314.7
	10	9.99340.3	9.99334.4	9.99328.6	9.99323.1	9.99317.9	9.99312.8
	20	9.99338.4	9.99332.4	9.99326.7	9.99321.2	9.99315.9	9.99310.8
	30	9.99336.5	9.99330.5	9.99324.8	9.99319.2	9.99313.9	9.99308.8
	40	9.99334.6	9.99328.6	9.99322.8	9.99317.2	9.99311.9	9.99306.8
	50	9.99332.7	9.99326.7	9.99320.9	9.99315.3	9.99310.0	9.99304.8
61	0	9.99330.8	9.99324.3	9.99318.9	9.99313.3	9.99308.0	9.99302.8
	10	9.99328.9	9.99322.8	9.99317.0	9.99311.4	9.99306.0	9.99300.8
	20	9.99327.0	9.99320.9	9.99315.0	9.99309.4	9.99304.0	9.99298.8
	30	9.99325.0	9.99318.9	9.99313.1	9.99307.5	9.99302.1	9.99296.8
	40	9.99323.1	9.99317.0	9.99311.1	9.99305.5	9.99300.1	9.99294.8
	50	9.99321.2	9.99315.1	9.99309.2	9.99303.5	9.99298.1	9.99292.8
62	0	9.99319.3	9.99314.1	9.99307.2	9.99301.6	9.99296.1	9.99290.8

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the
Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		69°	70°	71°	72°	73°	74°
	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99393.9	9.99389.8	9.99385.8	9.99382.2	9.99378.8	9.99375.3
	10	9.99391.9	9.99387.8	9.99383.8	9.99380.2	9.99376.7	9.99373.2
	20	9.99389.9	9.99385.8	9.99381.7	9.99378.1	9.99374.6	9.99371.2
	30	9.99387.9	9.99383.8	9.99379.7	9.99376.1	9.99372.6	9.99369.1
	40	9.99385.9	9.99381.8	9.99377.7	9.99374.0	9.99370.5	9.99367.1
	50	9.99383.9	9.99379.8	9.99375.7	9.99372.0	9.99368.4	9.99365.0
54	0	9.99381.8	9.99377.7	9.99373.7	9.99369.9	9.99366.4	9.99363.0
	10	9.99379.8	9.99375.7	9.99371.6	9.99367.9	9.99364.3	9.99361.9
	20	9.99377.8	9.99373.7	9.99369.6	9.99365.8	9.99362.3	9.99358.8
	30	9.99375.8	9.99371.7	9.99367.6	9.99363.8	9.99360.2	9.99356.8
	40	9.99373.8	9.99369.7	9.99365.6	9.99361.7	9.99358.2	9.99354.7
	50	9.99371.8	9.99367.7	9.99363.6	9.99359.7	9.99356.1	9.99352.9
55	0	9.99369.8	9.99365.6	9.99361.5	9.99357.6	9.99354.1	9.99350.6
	10	9.99367.8	9.99363.6	9.99359.5	9.99355.6	9.99352.0	9.99348.5
	20	9.99365.8	9.99361.6	9.99357.5	9.99353.0	9.99350.0	9.99346.4
	30	9.99363.8	9.99359.6	9.99355.5	9.99351.5	9.99347.9	9.99344.4
	40	9.99361.8	9.99357.6	9.99353.5	9.99349.5	9.99345.9	9.99342.3
	50	9.99359.8	9.99355.6	9.99351.4	9.99347.5	9.99343.8	9.99340.2
56	0	9.99357.8	9.99353.5	9.99349.4	9.99345.5	9.99341.8	9.99338.2
	10	9.99355.8	9.99351.5	9.99347.4	9.99343.4	9.99339.7	9.99336.1
	20	9.99353.8	9.99349.5	9.99345.4	9.99341.4	9.99337.7	9.99334.0
	30	9.99351.8	9.99347.5	9.99343.4	9.99339.4	9.99335.6	9.99332.0
	40	9.99349.8	9.99345.5	9.99341.5	9.99337.3	9.99333.6	9.99329.9
	50	9.99347.8	9.99343.5	9.99339.5	9.99335.3	9.99331.5	9.99327.8
57	0	9.99345.8	9.99341.5	9.99337.5	9.99333.3	9.99329.5	9.99325.8
	10	9.99343.8	9.99339.4	9.99335.3	9.99331.2	9.99327.4	9.99323.7
	20	9.99341.8	9.99337.4	9.99333.2	9.99329.2	9.99325.4	9.99321.7
	30	9.99339.8	9.99335.4	9.99331.2	9.99327.2	9.99323.3	9.99319.6
	40	9.99337.8	9.99333.4	9.99329.2	9.99325.1	9.99321.3	9.99317.6
	50	9.99335.8	9.99331.4	9.99327.2	9.99323.1	9.99319.2	9.99315.5
58	0	9.99333.8	9.99329.4	9.99325.1	9.99321.1	9.99317.2	9.99313.5
	10	9.99331.8	9.99327.3	9.99323.1	9.99319.0	9.99315.1	9.99311.4
	20	9.99329.8	9.99325.3	9.99321.1	9.99317.0	9.99313.1	9.99309.4
	30	9.99327.8	9.99323.3	9.99319.1	9.99314.9	9.99311.0	9.99307.3
	40	9.99325.8	9.99321.3	9.99317.0	9.99312.9	9.99309.0	9.99305.3
	50	9.99323.8	9.99319.3	9.99315.0	9.99310.8	9.99306.9	9.99303.2
59	0	9.99321.8	9.99317.3	9.99313.0	9.99308.8	9.99304.9	9.99301.2
	10	9.99319.8	9.99315.2	9.99311.0	9.99306.8	9.99302.8	9.99299.1
	20	9.99317.8	9.99313.2	9.99308.9	9.99304.7	9.99300.8	9.99297.0
	30	9.99315.8	9.99311.2	9.99306.9	9.99302.7	9.99298.7	9.99295.0
	40	9.99313.8	9.99309.2	9.99304.9	9.99300.7	9.99296.7	9.99292.9
	50	9.99311.8	9.99307.2	9.99302.9	9.99298.6	9.99294.6	9.99290.8
60	0	9.99309.8	9.99305.2	9.99300.8	9.99296.6	9.99292.6	9.99288.8
	10	9.99307.8	9.99303.1	9.99298.8	9.99294.6	9.99290.5	9.99286.7
	20	9.99305.8	9.99301.1	9.99296.8	9.99292.5	9.99288.5	9.99284.7
	30	9.99303.8	9.99299.1	9.99294.8	9.99290.5	9.99286.4	9.99282.6
	40	9.99301.8	9.99297.1	9.99292.7	9.99288.5	9.99284.4	9.99280.6
	50	9.99299.8	9.99295.1	9.99290.7	9.99286.4	9.99282.3	9.99278.5
61	0	9.99297.8	9.99293.1	9.99288.7	9.99284.4	9.99280.3	9.99276.5
	10	9.99295.8	9.99291.0	9.99286.7	9.99282.4	9.99278.2	9.99274.4
	20	9.99293.8	9.99289.0	9.99284.6	9.99280.3	9.99276.2	9.99272.3
	30	9.99291.8	9.99287.0	9.99282.6	9.99278.3	9.99274.1	9.99270.3
	40	9.99289.8	9.99285.0	9.99280.6	9.99276.2	9.99272.1	9.99268.2
	50	9.99287.8	9.99283.0	9.99278.6	9.99274.2	9.99270.0	9.99266.1
62	0	9.99285.8	9.99281.0	9.99276.5	9.99272.1	9.99268.0	9.99264.1

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the
Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		75°	76°	77°	78°	79°	80°
		Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
M	S						
53	0	9.99372.1	9.99369.1	9.99366.4	9.99364.0	9.99361.7	9.99359.5
	10	9.99370.0	9.99367.0	9.99364.3	9.99361.9	9.99359.6	9.99357.4
	20	9.99367.9	9.99364.9	9.99362.3	9.99359.8	9.99357.5	9.99355.3
	30	9.99365.9	9.99362.9	9.99360.2	9.99357.7	9.99355.4	9.99353.2
	40	9.99363.8	9.99360.8	9.99358.1	9.99355.6	9.99353.3	9.99351.1
	50	9.99361.7	9.99358.7	9.99356.0	9.99353.5	9.99351.2	9.99349.0
54	0	9.99359.7	9.99356.7	9.99354.0	9.99351.4	9.99349.1	9.99346.9
	10	9.99357.6	9.99354.6	9.99351.9	9.99349.3	9.99347.0	9.99344.8
	20	9.99355.5	9.99352.5	9.99349.8	9.99347.2	9.99344.9	9.99342.7
	30	9.99353.5	9.99350.5	9.99347.7	9.99345.1	9.99342.8	9.99340.6
	40	9.99351.4	9.99348.4	9.99345.6	9.99343.0	9.99340.7	9.99338.5
	50	9.99349.3	9.99346.3	9.99343.6	9.99341.0	9.99338.6	9.99336.4
55	0	9.99347.3	9.99344.3	9.99341.5	9.99338.8	9.99336.5	9.99334.3
	10	9.99345.2	9.99342.2	9.99339.4	9.99336.7	9.99334.4	9.99332.2
	20	9.99343.1	9.99340.1	9.99337.3	9.99334.7	9.99332.5	9.99330.3
	30	9.99341.1	9.99338.0	9.99335.2	9.99332.6	9.99330.3	9.99328.0
	40	9.99339.0	9.99336.0	9.99333.1	9.99330.5	9.99328.1	9.99325.9
	50	9.99336.9	9.99333.9	9.99331.0	9.99328.4	9.99326.0	9.99323.8
56	0	9.99334.9	9.99331.8	9.99328.9	9.99326.3	9.99323.6	9.99321.7
	10	9.99332.8	9.99329.7	9.99326.9	9.99324.2	9.99321.8	9.99319.6
	20	9.99330.7	9.99327.6	9.99324.8	9.99322.1	9.99319.7	9.99317.5
	30	9.99328.7	9.99325.5	9.99322.7	9.99320.0	9.99317.6	9.99315.4
	40	9.99326.6	9.99323.4	9.99320.6	9.99317.9	9.99315.5	9.99313.3
	50	9.99324.5	9.99321.4	9.99318.5	9.99315.8	9.99313.4	9.99311.1
57	0	9.99322.5	9.99319.3	9.99316.4	9.99313.7	9.99311.3	9.99309.0
	10	9.99320.4	9.99317.2	9.99314.4	9.99311.7	9.99309.2	9.99306.9
	20	9.99318.3	9.99315.1	9.99312.3	9.99309.6	9.99307.1	9.99304.8
	30	9.99316.3	9.99313.1	9.99310.2	9.99307.5	9.99305.0	9.99302.7
	40	9.99314.2	9.99311.0	9.99308.1	9.99305.4	9.99302.9	9.99300.6
	50	9.99312.1	9.99308.9	9.99306.0	9.99303.3	9.99300.8	9.99298.5
58	0	9.99310.1	9.99306.8	9.99303.9	9.99301.2	9.99298.7	9.99296.4
	10	9.99308.0	9.99304.7	9.99301.8	9.99299.1	9.99296.6	9.99294.3
	20	9.99305.9	9.99302.7	9.99299.7	9.99297.0	9.99294.5	9.99292.2
	30	9.99303.9	9.99300.6	9.99297.7	9.99294.9	9.99292.4	9.99290.1
	40	9.99301.8	9.99298.5	9.99295.6	9.99292.8	9.99290.2	9.99288.0
	50	9.99299.7	9.99296.4	9.99293.5	9.99290.7	9.99288.1	9.99285.8
59	0	9.99297.7	9.99294.4	9.99291.4	9.99288.6	9.99286.0	9.99283.7
	10	9.99295.6	9.99292.3	9.99289.3	9.99286.5	9.99283.9	9.99281.6
	20	9.99293.5	9.99290.2	9.99287.2	9.99284.4	9.99281.8	9.99279.5
	30	9.99291.5	9.99288.1	9.99285.1	9.99282.3	9.99279.7	9.99277.4
	40	9.99289.4	9.99286.0	9.99283.0	9.99280.2	9.99277.6	9.99275.2
	50	9.99287.3	9.99284.0	9.99281.0	9.99278.1	9.99275.5	9.99273.1
60	0	9.99285.3	9.99281.9	9.99278.8	9.99276.0	9.99273.4	9.99271.0
	10	9.99283.2	9.99279.8	9.99276.8	9.99273.9	9.99271.3	9.99268.9
	20	9.99281.1	9.99277.7	9.99274.7	9.99271.8	9.99269.2	9.99266.8
	30	9.99279.1	9.99275.6	9.99272.6	9.99269.7	9.99267.1	9.99264.7
	40	9.99277.0	9.99273.6	9.99270.5	9.99267.6	9.99265.0	9.99262.6
	50	9.99274.9	9.99271.5	9.99268.4	9.99265.5	9.99262.9	9.99260.5
61	0	9.99272.9	9.99269.4	9.99266.3	9.99263.4	9.99260.8	9.99258.4
	10	9.99270.8	9.99267.3	9.99264.2	9.99261.4	9.99258.7	9.99256.3
	20	9.99268.7	9.99265.3	9.99262.1	9.99259.3	9.99256.6	9.99254.2
	30	9.99266.6	9.99263.2	9.99260.0	9.99257.2	9.99254.5	9.99252.0
	40	9.99264.5	9.99261.1	9.99258.0	9.99255.1	9.99252.4	9.99249.9
	50	9.99262.5	9.99259.0	9.99255.9	9.99253.0	9.99250.3	9.99247.8
62	0	9.99260.4	9.99257.0	9.99253.8	9.99250.9	9.99248.2	9.99245.7

T A B L E IV.
Logarithms for computing the true Distance of the Moon from the
Sun or a fixed Star.

Moon's horizontal Parallax.		Apparent Altitude of the Moon's Centre.					
		81°	82°	83°	84°	85°	86°
	S	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99357.7	9.99356.0	9.99354.5	9.99353.2	9.99352.1	9.99351.2
	10	9.99355.6	9.99353.9	9.99352.3	9.99351.1	9.99350.0	9.99349.1
	20	9.99353.5	9.99351.8	9.99350.2	9.99348.9	9.99347.8	9.99346.9
	30	9.99351.3	9.99349.6	9.99348.1	9.99346.8	9.99345.7	9.99344.8
	40	9.99349.2	9.99347.5	9.99346.0	9.99344.7	9.99343.6	9.99342.7
	50	9.99347.1	9.99345.4	9.99343.9	9.99342.6	9.99341.5	9.99340.5
54	0	9.99345.0	9.99343.3	9.99341.8	9.99340.5	9.99339.3	9.99338.4
	10	9.99342.9	9.99341.2	9.99339.7	9.99338.3	9.99337.2	9.99336.2
	20	9.99340.8	9.99339.0	9.99337.5	9.99336.2	9.99335.1	9.99334.1
	30	9.99338.7	9.99336.9	9.99335.4	9.99334.1	9.99332.9	9.99331.9
	40	9.99336.5	9.99334.8	9.99333.3	9.99332.0	9.99330.8	9.99329.8
	50	9.99334.4	9.99332.7	9.99331.2	9.99329.8	9.99328.7	9.99327.7
55	0	9.99332.3	9.99330.6	9.99329.0	9.99327.7	9.99326.5	9.99325.5
	10	9.99330.2	9.99328.4	9.99326.9	9.99325.6	9.99324.4	9.99323.4
	20	9.99328.1	9.99326.3	9.99324.7	9.99323.4	9.99322.3	9.99321.3
	30	9.99326.0	9.99324.2	9.99322.6	9.99321.3	9.99320.1	9.99319.1
	40	9.99323.8	9.99322.1	9.99320.5	9.99319.2	9.99318.0	9.99317.0
	50	9.99321.7	9.99320.0	9.99318.4	9.99317.1	9.99315.9	9.99314.9
56	0	9.99319.6	9.99317.8	9.99316.2	9.99314.9	9.99313.7	9.99312.7
	10	9.99317.5	9.99315.7	9.99314.1	9.99312.8	9.99311.6	9.99310.6
	20	9.99315.4	9.99313.6	9.99312.0	9.99310.6	9.99309.5	9.99308.5
	30	9.99313.3	9.99311.5	9.99309.8	9.99308.5	9.99307.3	9.99306.3
	40	9.99311.1	9.99309.4	9.99307.7	9.99306.4	9.99305.2	9.99304.2
	50	9.99309.0	9.99307.2	9.99305.6	9.99304.2	9.99303.1	9.99302.1
57	0	9.99306.9	9.99305.1	9.99303.5	9.99302.1	9.99300.9	9.99299.9
	10	9.99304.8	9.99303.0	9.99301.3	9.99299.9	9.99298.8	9.99297.8
	20	9.99302.7	9.99300.9	9.99299.2	9.99297.8	9.99296.7	9.99295.7
	30	9.99300.6	9.99298.8	9.99297.1	9.99295.7	9.99294.6	9.99293.5
	40	9.99298.5	9.99296.6	9.99295.0	9.99293.6	9.99292.4	9.99291.4
	50	9.99296.4	9.99294.5	9.99292.8	9.99291.4	9.99290.3	9.99289.3
58	0	9.99294.3	9.99292.4	9.99290.7	9.99289.3	9.99288.1	9.99287.1
	10	9.99292.1	9.99290.3	9.99288.6	9.99287.1	9.99286.0	9.99285.0
	20	9.99290.0	9.99288.1	9.99286.5	9.99285.0	9.99283.9	9.99282.9
	30	9.99287.9	9.99286.0	9.99284.3	9.99282.9	9.99281.7	9.99280.7
	40	9.99285.8	9.99283.9	9.99282.2	9.99280.7	9.99279.6	9.99278.6
	50	9.99283.7	9.99281.8	9.99280.1	9.99278.6	9.99277.5	9.99276.5
59	0	9.99281.6	9.99279.7	9.99278.0	9.99276.5	9.99275.3	9.99274.3
	10	9.99279.5	9.99277.5	9.99275.8	9.99274.4	9.99273.2	9.99272.2
	20	9.99277.3	9.99275.4	9.99273.7	9.99272.2	9.99271.1	9.99270.1
	30	9.99275.2	9.99273.3	9.99271.6	9.99270.1	9.99269.0	9.99267.9
	40	9.99273.1	9.99271.2	9.99269.5	9.99268.0	9.99266.8	9.99265.8
	50	9.99271.0	9.99269.1	9.99267.3	9.99265.9	9.99264.7	9.99263.7
60	0	9.99268.9	9.99266.9	9.99265.2	9.99263.8	9.99262.5	9.99261.5
	10	9.99266.8	9.99264.8	9.99263.1	9.99261.6	9.99260.4	9.99259.4
	20	9.99264.7	9.99262.7	9.99261.0	9.99259.5	9.99258.3	9.99257.3
	30	9.99262.6	9.99260.6	9.99258.8	9.99257.4	9.99256.1	9.99255.1
	40	9.99260.4	9.99258.5	9.99256.7	9.99255.2	9.99254.0	9.99253.0
	50	9.99258.3	9.99256.3	9.99254.6	9.99253.1	9.99251.9	9.99250.8
61	0	9.99256.2	9.99254.2	9.99252.5	9.99251.0	9.99249.7	9.99248.7
	10	9.99254.1	9.99252.1	9.99250.3	9.99248.8	9.99247.6	9.99246.5
	20	9.99252.0	9.99250.0	9.99248.2	9.99246.7	9.99245.5	9.99244.4
	30	9.99249.9	9.99247.9	9.99246.1	9.99244.6	9.99243.3	9.99242.3
	40	9.99247.8	9.99245.7	9.99244.0	9.99242.4	9.99241.2	9.99240.1
	50	9.99245.6	9.99243.6	9.99241.8	9.99240.3	9.99239.1	9.99238.0
62	0	9.99243.5	9.99241.5	9.99239.7	9.99238.2	9.99236.9	9.99235.8

T A B L E IV. Logarithms for computing the true Distance of the Moon from the Sun or a fixed Star.

		Apparent Altitude of the Moon's Centre.			
Moon's horizontal Parallax.		87°	88°	89°	90°
M	S.	Logarithm.	Logarithm.	Logarithm.	Logarithm.
53	0	9.99350.5	9.99349.9	9.99349.7	9.99349.5
	10	9.99348.3	9.99347.7	9.99347.5	9.99347.4
	20	9.99346.2	9.99345.6	9.99345.4	9.99345.2
	30	9.99344.1	9.99343.5	9.99343.2	9.99343.1
	40	9.99341.9	9.99341.3	9.99341.1	9.99340.9
	50	9.99339.8	9.99339.2	9.99338.9	9.99338.8
54	0	9.99337.7	9.99337.1	9.99336.8	9.99336.6
	10	9.99335.5	9.99334.9	9.99334.6	9.99334.6
	20	9.99333.4	9.99332.8	9.99332.5	9.99332.3
	30	9.99331.3	9.99330.6	9.99330.3	9.99330.1
	40	9.99329.1	9.99328.5	9.99328.2	9.99328.0
	50	9.99327.0	9.99326.4	9.99326.1	9.99325.8
55	0	9.99324.8	9.99324.2	9.99323.9	9.99323.7
	10	9.99322.7	9.99322.1	9.99321.8	9.99321.5
	20	9.99320.5	9.99319.9	9.99319.7	9.99319.4
	30	9.99318.4	9.99317.8	9.99317.5	9.99317.2
	40	9.99316.3	9.99315.6	9.99315.4	9.99315.1
	50	9.99314.1	9.99313.5	9.99313.2	9.99312.9
56	0	9.99312.0	9.99311.4	9.99311.1	9.99310.8
	10	9.99309.8	9.99309.2	9.99309.0	9.99308.7
	20	9.99307.7	9.99307.1	9.99306.8	9.99306.5
	30	9.99305.6	9.99304.9	9.99304.7	9.99304.4
	40	9.99303.4	9.99302.8	9.99302.5	9.99302.3
	50	9.99301.3	2.99300.7	9.99300.4	9.99300.1
57	0	9.99299.1	9.99298.5	9.99298.2	9.99298.0
	10	9.99297.0	9.99296.4	9.99296.1	9.99295.9
	20	9.99294.9	9.99294.3	9.99294.0	9.99293.8
	30	9.99292.7	9.99292.1	9.99291.8	9.99291.7
	40	9.99290.6	9.99290.0	9.99289.7	9.99289.5
	50	9.99288.5	9.99287.9	9.99287.6	9.99287.4
58	0	9.99286.3	9.99285.7	9.99285.4	9.99285.3
	10	9.99284.2	9.99283.6	9.99283.3	9.99283.1
	20	9.99282.1	9.99281.4	9.99281.2	9.99281.0
	30	9.99279.9	9.99279.3	9.99279.1	9.99278.8
	40	9.99277.8	9.99277.1	9.99276.9	9.99276.7
	50	9.99275.7	9.99275.0	9.99274.8	9.99274.6
59	0	9.99273.5	9.99272.9	9.99272.6	9.99272.5
	10	9.99271.4	9.99270.7	9.99270.5	9.99270.3
	20	9.99269.3	9.99268.6	9.99268.3	9.99268.2
	30	9.99267.1	9.99266.4	9.99266.2	9.99266.0
	40	9.99265.0	9.99264.3	9.99264.0	9.99263.9
	50	9.99262.9	9.99262.2	9.99261.9	9.99262.7
60	0	9.99260.7	9.99260.0	9.99259.7	9.99259.6
	10	9.99258.6	9.99257.9	9.99257.6	9.99257.4
	20	9.99256.5	9.99255.8	9.99255.5	9.99255.3
	30	9.99254.3	9.99253.7	9.99253.3	9.99253.1
	40	9.99252.2	9.99251.5	9.99251.2	9.99251.0
	50	9.99250.1	9.99249.4	9.99249.0	9.99248.8
61	0	9.99247.9	9.99247.2	9.99246.9	9.99246.7
	10	9.99245.8	9.99245.1	9.99244.8	9.99244.5
	20	9.99243.6	9.99243.0	9.99242.6	9.99242.4
	30	9.99241.5	9.99240.8	9.99240.5	9.99240.2
	40	9.99239.3	9.99238.7	9.99238.3	9.99238.1
	50	9.99237.2	9.99236.6	9.99236.2	9.99235.9
62	0	9.99235.0	9.99234.4	9.99234.0	9.99233.8

T A B L E IV.

For turning Degrees and Minutes into Time and the contrary.

D	H M	D	H M	D	H M	D	H M	D	H M	D	H M
M	MS	M	MS	M	MS	M	MS	M	MS	M	MS
1	0. 4	61	4. 4	121	8. 4	181	12. 4	241	16. 4	301	20. 4
2	0. 8	62	4. 8	122	8. 8	182	12. 8	242	16. 8	302	20. 8
3	0. 12	63	4. 12	123	8. 12	183	12. 12	243	16. 12	303	20. 12
4	0. 16	64	4. 16	124	8. 16	184	12. 16	244	16. 16	304	20. 16
5	0. 20	65	4. 20	125	8. 20	185	12. 20	245	16. 20	305	20. 20
6	0. 24	66	4. 24	126	8. 24	186	12. 24	246	16. 24	306	20. 24
7	0. 28	67	4. 28	127	8. 28	187	12. 28	247	16. 28	307	20. 28
8	0. 32	68	4. 32	128	8. 32	188	12. 32	248	16. 32	308	20. 32
9	0. 36	69	4. 36	129	8. 36	189	12. 36	249	16. 36	309	20. 36
10	0. 40	70	4. 40	130	8. 40	190	12. 40	250	16. 40	310	20. 40
11	0. 44	71	4. 44	131	8. 44	191	12. 44	251	16. 44	311	20. 44
12	0. 48	72	4. 48	132	8. 48	192	12. 48	252	16. 48	312	20. 48
13	0. 52	73	4. 52	133	8. 52	193	12. 52	253	16. 52	313	20. 52
14	0. 56	74	4. 56	134	8. 56	194	12. 56	254	16. 56	314	20. 56
15	1. 0	75	5. 0	135	9. 0	195	13. 0	255	17. 0	315	21. 0
16	1. 4	76	5. 4	136	9. 4	196	13. 4	256	17. 4	316	21. 4
17	1. 8	77	5. 8	137	9. 8	197	13. 8	257	17. 8	317	21. 8
18	1. 12	78	5. 12	138	9. 12	198	13. 12	258	17. 12	318	21. 12
19	1. 16	79	5. 16	139	9. 16	199	13. 16	259	17. 16	319	21. 16
20	1. 20	80	5. 20	140	9. 20	200	13. 20	260	17. 20	320	21. 20
21	1. 24	81	5. 24	141	9. 24	201	13. 24	261	17. 24	321	21. 24
22	1. 28	82	5. 28	142	9. 28	202	13. 28	262	17. 28	322	21. 28
23	1. 32	83	5. 32	143	9. 32	203	13. 32	263	17. 32	323	21. 32
24	1. 36	84	5. 36	144	9. 36	204	13. 36	264	17. 36	324	21. 36
25	1. 40	85	5. 40	145	9. 40	205	13. 40	265	17. 40	325	21. 40
26	1. 44	86	5. 44	146	9. 44	206	13. 44	266	17. 44	326	21. 44
27	1. 48	87	5. 48	147	9. 48	207	13. 48	267	17. 48	327	21. 48
28	1. 52	88	5. 52	148	9. 52	208	13. 52	268	17. 52	328	21. 52
29	1. 56	89	5. 56	149	9. 56	209	13. 56	269	17. 56	329	21. 56
30	2. 0	90	6. 0	150	10. 0	210	14. 0	270	18. 0	330	22. 0
31	2. 4	91	6. 4	151	10. 4	211	14. 4	271	18. 4	331	22. 4
32	2. 8	92	6. 8	152	10. 8	212	14. 8	272	18. 8	332	22. 8
33	2. 12	93	6. 12	153	10. 12	213	14. 12	273	18. 12	333	22. 12
34	2. 16	94	6. 16	154	10. 16	214	14. 16	274	18. 16	334	22. 16
35	2. 20	95	6. 20	155	10. 20	215	14. 20	275	18. 20	335	22. 20
36	2. 24	96	6. 24	156	10. 24	216	14. 24	276	18. 24	336	22. 24
37	2. 28	97	6. 28	157	10. 28	217	14. 28	277	18. 28	337	22. 28
38	2. 32	98	6. 32	158	10. 32	218	14. 32	278	18. 32	338	22. 32
39	2. 36	99	6. 36	159	10. 36	219	14. 36	279	18. 36	339	22. 36
40	2. 40	100	6. 40	160	10. 40	220	14. 40	280	18. 40	340	22. 40
41	2. 44	101	6. 44	161	10. 44	221	14. 44	281	18. 44	341	22. 44
42	2. 48	102	6. 48	162	10. 48	222	14. 48	282	18. 48	342	22. 48
43	2. 52	103	6. 52	163	10. 52	223	14. 52	283	18. 52	343	22. 52
44	2. 56	104	6. 56	164	10. 56	224	14. 56	284	18. 56	344	22. 56
45	3. 0	105	7. 0	165	11. 0	225	15. 0	285	19. 0	345	23. 0
46	3. 4	106	7. 4	166	11. 4	226	15. 4	286	19. 4	346	23. 4
47	3. 8	107	7. 8	167	11. 8	227	15. 8	287	19. 8	347	23. 8
48	3. 12	108	7. 12	168	11. 12	228	15. 12	288	19. 12	348	23. 12
49	3. 16	109	7. 16	169	11. 16	229	15. 16	289	19. 16	349	23. 16
50	3. 20	110	7. 20	170	11. 20	230	15. 20	290	19. 20	350	23. 20
51	3. 24	111	7. 24	171	11. 24	231	15. 24	291	19. 24	351	23. 24
52	3. 28	112	7. 28	172	11. 28	232	15. 28	292	19. 28	352	23. 28
53	3. 32	113	7. 32	173	11. 32	233	15. 32	293	19. 32	353	23. 32
54	3. 36	114	7. 36	174	11. 36	234	15. 36	294	19. 36	354	23. 36
55	3. 40	115	7. 40	175	11. 40	235	15. 40	295	19. 40	355	23. 40
56	3. 44	116	7. 44	176	11. 44	236	15. 44	296	19. 44	356	23. 44
57	3. 48	117	7. 48	177	11. 48	237	15. 48	297	19. 48	357	23. 48
58	3. 52	118	7. 52	178	11. 52	238	15. 52	298	19. 52	358	23. 52
59	3. 56	119	7. 56	179	11. 56	239	15. 56	299	19. 56	359	23. 56
60	4. 0	120	8. 0	180	12. 0	240	16. 0	300	20. 0	360	24. 0

REMARK.—Many People are at a Loss, who have not a Celestial Globe by them to know the Stars; to these I would wish to give this

G E N E R A L R U L E.

BY the Directions in this Book find when any Star comes to the Meridian. Take the Declination of the Star, to which add the supposed Latitude, if the Latitude and Declination are of a contrary Name, that is one North and the other South, but if both North or South, subtract the one from the other, and call the Sum or Difference the Complement of Altitude, this Complement subtracted from 90° gives the Altitude; if this Altitude nearly corresponds with that on your Quadrant, you are certain you have taken the Altitude of the Right Star, otherwise not.

E X A M P L E I.

Suppose on July 30th, at 9 H. 27 M. Required what Star will be on the Meridian of London, and its Altitude.

Sun's Right Ascension	8° 38'	Sagittarius's Declination	34° 27'S.
Given Time	9 27	Lat.	51 32
Answer to Sagittarius	18 5	Co. Alt.	85 59
			90
		Altitude	4 1

E X A M P L E II.

In Latitude $21^\circ 40'$ N. and Longitude 30° West; required what Star will be on the Meridian, as also its Altitude on the 15th of November at 10 H. 20 M. from Noon?

Sun's Right Ascension	15° 22'S.	Star's Declination	27° 52' 13"N.
Time from Noon	10 30	Sub. Lat.	21 40 00 N.
Star nearest is Head of Andromeda	25 52	Co. Alt.	6 12 13
			90
			83 47 47 Alt.

To find the Logarithm of any whole Number, from 1000 to 10,000, or more

N. B. The Index of all Logarithms from 1,000 to 9,999 is 3; from that to 99,999 is 4; and from that to 9,99999 is 5; and from that to 10,00000 is 6.

To find the Log. of 1201.

RULE. Take the Logarithm of the three first Figures, viz. of 120 and one-tenth, and as it is above 1000 make 3 the Index, and it will be 3.08278. And if you wanted 4006, take the Log. of 400, and six-tenths, prefix the Index 3 to it, and it will be 3.85260; and so of any other to 9999.

To find the Log. of any whole Number to five Places—Suppose 11293.

RULE. Find Log. of the first four Figures, viz. 1129, as in Rule I. here; which is 4.05269; then take the Log. for the next greatest whole Number to 1129, which is 1130, the Log. whereof with 4 for Index is 4.05307, their Difference is 38; then say, if 10 gives 38 what will 3, the last Figure in your Number give, which is 11; this added to your first Log. viz. 4.05307, gives 4.05280, the Log. of 11293, which was required.

To find the Log. of any whole Number to 6 Places—Suppose 167854.

RULE. Find the Log. for the four first Figures as before; and as it is to 6 Places the Index will be 5; the Log. then to 1678, with this Index will be 5.22479; then take the Log of the next greatest whole Number, viz. 1679, with 5 for Index, which will be 5.22505, their Difference being 26, say, if 100 gives 26, what will 54 (your two last cut off Figures) give; which will produce 14 to be added to the Log of 1678, and this will give 5.22493, the Log. of 167854, the Number sought, and so of any other.

Difference of Latitude and Departure for $\frac{1}{2}$ Point.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	22	121.9	06.0	82	181.8	08.9	42	241.7	11.9
3	03.0	00.1	63	62.9	03.1	23	122.9	06.0	83	182.8	09.0	43	242.7	11.9
4	04.0	00.2	64	63.9	03.1	24	123.9	06.1	84	183.8	09.0	44	243.7	12.0
5	05.0	00.2	65	64.9	03.2	25	124.9	06.1	85	184.8	09.1	45	244.7	12.0
6	06.0	00.3	66	65.9	03.2	26	125.8	06.2	86	185.8	09.1	46	245.7	12.1
7	07.0	00.3	67	66.9	03.3	27	126.8	06.2	87	186.8	09.2	47	246.7	12.1
8	08.0	00.4	68	67.9	03.3	28	127.8	06.3	88	187.8	09.2	48	247.7	12.2
9	09.0	00.4	69	68.9	03.4	29	128.8	06.3	89	188.8	09.3	49	248.7	12.2
10	10.0	00.5	70	69.9	03.4	30	129.8	06.4	90	189.8	09.3	50	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	32	131.8	06.5	92	191.8	09.4	52	251.7	12.4
13	13.0	00.6	73	72.9	03.6	33	132.8	06.5	93	192.8	09.5	53	252.7	12.4
14	14.0	00.7	74	73.9	03.6	34	133.8	06.6	94	193.8	09.5	54	253.7	12.5
15	15.0	00.7	75	74.9	03.7	35	134.8	06.6	95	194.8	09.6	55	254.7	12.5
16	16.0	00.8	76	75.9	03.7	36	135.8	06.7	96	195.8	09.6	56	255.7	12.6
17	17.0	00.8	77	76.9	03.8	37	136.8	06.7	97	196.8	09.7	57	256.7	12.6
18	18.0	00.9	78	77.9	03.8	38	137.8	06.8	98	197.8	09.7	58	257.7	12.7
19	19.0	00.9	79	78.9	03.9	39	138.8	06.8	99	198.8	09.8	59	258.7	12.7
20	20.0	01.0	80	79.9	03.9	40	139.8	06.9	200	199.8	09.8	60	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	42	141.8	07.0	02	201.8	09.9	62	261.7	12.9
23	23.0	01.1	83	82.9	04.1	43	142.8	07.0	03	202.8	10.0	63	262.7	12.9
24	24.0	01.2	84	83.9	04.1	44	143.8	07.1	04	203.8	10.0	64	263.7	13.0
25	25.0	01.2	85	84.9	04.2	45	144.8	07.1	05	204.8	10.1	65	264.7	13.0
26	26.0	01.3	86	85.9	04.2	46	145.8	07.2	06	205.8	10.1	66	265.7	13.1
27	27.0	01.3	87	86.9	04.3	47	146.8	07.2	07	206.8	10.2	67	266.7	13.1
28	28.0	01.4	88	87.9	04.3	48	147.8	07.3	08	207.7	10.2	68	267.7	13.2
29	29.0	01.4	89	88.9	04.4	49	148.8	07.3	09	208.7	10.3	69	268.7	13.2
30	30.0	01.5	90	89.9	04.4	50	149.8	07.4	10	209.7	10.3	70	269.7	1

Difference of Latitude and Departure for $\frac{1}{2}$ Point.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.7	06.0	121	120.4	11.8	181	180.1	17.7	241	239.8	23.6
2	02.0	00.2	62	61.7	06.1	22	121.4	11.9	82	181.1	17.8	42	240.8	23.7
3	03.0	00.3	63	62.7	06.2	23	122.4	12.0	83	181.3	17.9	43	241.8	23.8
4	04.0	00.4	64	63.7	06.3	24	123.4	12.1	84	183.1	18.0	44	242.8	23.9
5	05.0	00.5	65	64.7	06.4	25	124.4	12.2	85	184.1	18.1	45	243.8	24.0
6	06.0	00.6	66	65.7	06.5	26	125.4	12.3	86	185.1	18.2	46	244.8	24.1
7	07.0	00.7	67	66.7	06.6	27	126.4	12.4	87	186.1	18.3	47	245.8	24.2
8	08.0	00.8	68	67.7	06.7	28	127.4	12.5	88	187.1	18.4	48	246.8	24.3
9	09.0	00.9	69	68.7	06.7	29	128.4	12.6	89	188.1	18.5	49	247.8	24.4
10	10.0	01.0	70	69.7	06.8	30	129.4	12.7	90	189.1	18.6	50	248.8	24.5
11	10.9	01.1	71	70.7	06.9	31	130.4	12.8	91	190.1	18.7	51	249.8	24.6
12	11.9	01.2	72	71.7	07.0	32	131.4	12.9	92	191.1	18.8	52	250.8	24.7
13	12.9	01.3	73	72.6	07.1	33	132.4	13.0	93	192.1	18.9	53	251.8	24.8
14	13.9	01.4	74	73.6	07.2	34	133.4	13.1	94	193.1	19.0	54	252.8	24.9
15	14.9	01.5	75	74.6	07.3	35	134.4	13.2	95	194.1	19.1	55	253.8	25.0
16	15.9	01.6	76	75.6	07.4	36	135.3	13.3	96	195.1	19.2	56	254.8	25.1
17	16.9	01.7	77	76.6	07.5	37	136.3	13.4	97	196.1	19.3	57	255.8	25.2
18	17.9	01.8	78	77.6	07.6	38	137.3	13.5	98	197.0	19.4	58	256.8	25.3
19	18.9	01.9	79	78.6	07.7	39	138.3	13.6	99	198.0	19.5	59	257.8	25.4
20	19.9	02.0	80	79.6	07.8	40	139.3	13.7	200	199.0	19.6	60	258.8	25.5
21	20.9	02.1	81	80.6	07.9	41	140.3	13.8	201	200.0	19.7	61	259.7	25.6
22	21.9	02.2	82	81.6	08.0	42	141.3	13.9	02	201.0	19.8	62	260.7	25.7
23	22.9	02.2	83	82.6	08.1	43	142.3	14.0	03	202.0	19.9	63	261.7	25.8
24	23.9	02.3	84	83.6	08.2	44	143.3	14.1	04	203.0	20.0	64	262.7	25.9
25	24.9	02.4	85	84.6	08.3	45	144.3	14.2	05	204.0	20.1	65	263.7	26.0
26	25.9	02.5	86	85.6	08.4	46	145.3	14.3	06	205.0	20.2	66	264.7	26.1
27	26.9	02.6	87	86.6	08.5	47	146.3	14.4	07	206.0	20.2	67	265.7	26.2
28	27.9	02.7	88	87.6	08.6	48	147.3	14.5	08	207.0	20.3	68	266.7	26.3
29	28.9	02.8	89	88.6	08.7	49	148.3	14.6	09	208.0	20.4	69	267.7	26.4
30	29.9	02.9	90	89.6	08.8	50	149.3	14.7	10	209.0	20.5	70	268.7	26.5
31	30.9	03.0	91	90.6	08.9	51	150.3	14.8	211	210.0	20.6	71	269.7	26.6
32	31.8	03.1	92	91.6	09.0	52	151.3	14.9	12	211.0	20.7	72	270.7	26.7
33	32.8	03.2	93	92.6	09.1	53	152.3	15.0	13	212.0	20.8	73	271.7	26.8
34	33.8	03.3	94	93.5	09.2	54	153.3	15.1	14	213.0	20.9	74	272.7	26.9
35	34.8	03.4	95	94.5	09.3	55	154.3	15.2	15	214.0	21.0	75	273.7	27.0
36	35.8	03.5	96	95.5	09.4	56	155.3	15.3	16	215.0	21.1	76	274.7	27.1
37	36.8	03.6	97	96.5	09.5	57	156.2	15.4	17	216.0	21.2	77	275.7	27.2
38	37.8	03.7	98	97.5	09.6	58	157.2	15.5	18	217.0	21.3	78	276.7	27.3
39	38.8	03.8	99	98.5	09.7	59	158.2	15.6	19	217.9	21.4	79	277.7	27.4
40	39.8	03.9	100	99.5	09.8	60	159.2	15.7	20	218.9	21.5	80	278.7	27.5
41	40.8	04.0	101	100.5	09.9	61	160.2	15.7	221	219.9	21.6	281	279.6	27.6
42	41.8	04.1	02	101.5	10.0	62	161.2	15.8	22	220.9	21.7	82	280.6	27.7
43	42.8	04.2	03	102.5	10.1	63	162.2	15.9	23	221.9	21.8	83	281.6	27.8
44	43.8	04.3	04	103.5	10.2	64	163.2	16.0	24	222.9	21.9	84	282.6	27.9
45	44.8	04.4	05	104.5	10.3	65	164.2	16.1	25	223.9	22.0	85	283.6	28.0
46	45.8	04.5	06	105.5	10.4	66	165.2	16.2	26	224.9	22.1	86	284.6	28.1
47	46.8	04.6	07	106.5	10.5	67	166.2	16.3	27	225.9	22.2	87	285.6	28.2
48	47.8	04.7	08	107.5	10.6	68	167.2	16.4	28	226.9	22.3	88	286.6	28.3
49	48.8	04.8	09	108.5	10.7	69	168.2	16.5	29	227.9	22.4	89	287.6	28.4
50	49.8	04.9	10	109.5	10.8	70	169.2	16.6	30	228.9	22.5	90	288.6	28.5
51	50.8	05.0	111	110.5	10.9	171	170.2	16.7	231	229.9	22.6	291	289.6	28.6
52	51.8	05.1	12	111.5	11.0	72	171.2	16.8	32	230.9	22.7	92	290.6	28.7
53	52.7	05.2	13	112.5	11.1	73	172.2	16.9	33	231.9	22.8	93	291.6	28.8
54	53.7	05.3	14	113.5	11.2	74	173.2	17.0	34	232.9	22.9	94	292.6	28.9
55	54.7	05.4	15	114.4	11.2	75	174.2	17.1	35	233.9	23.0	95	293.6	29.0
56	55.7	05.5	16	115.4	11.3	76	175.2	17.2	36	234.9	23.1	96	294.6	29.1
57	56.7	05.6	17	116.4	11.4	77	176.2	17.3	37	235.9	23.2	97	295.6	29.2
58	57.7	05.7	18	117.4	11.5	78	177.1	17.4	38	236.9	23.3	98	296.6	29.3
59	58.7	05.8	19	118.4	11.6	79	178.1	17.5	39	237.9	23.4	99	297.6	29.4
60	59.7	05.9	20	119.4	11.7	80	179.1	17.6	40	238.8	23.5	300	298.6	29.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for $7\frac{1}{2}$ Points.

Difference of Latitude and Departure for $\frac{3}{4}$ Points

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.3	08.9	121	119.7	17.7	181	179.0	20.5	241	238.4	35.3
2	02.0	00.3	62	61.3	09.1	122	120.7	17.8	182	180.0	20.7	242	239.4	35.5
3	03.0	00.4	63	62.3	09.2	123	121.7	18.0	183	181.0	20.8	243	240.4	35.6
4	04.0	00.6	64	63.3	09.4	124	122.7	18.2	184	182.0	21.0	244	241.4	35.8
5	04.9	00.7	65	64.3	09.5	125	123.6	18.3	185	183.0	21.1	245	242.3	35.9
6	05.9	00.9	66	65.3	09.7	126	124.6	18.5	186	184.0	21.3	246	243.3	36.1
7	06.9	01.0	67	66.3	09.8	127	125.6	18.6	187	185.0	21.4	247	244.3	36.2
8	07.9	01.2	68	67.3	10.0	128	126.6	18.8	188	186.0	21.6	248	245.3	36.4
9	08.9	01.3	69	68.2	10.1	129	127.6	18.9	189	186.9	21.7	249	246.3	36.5
10	09.9	01.5	70	69.2	10.3	130	128.6	19.1	190	187.9	21.9	250	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	22.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	132	130.6	19.4	192	189.9	22.2	252	249.3	37.0
13	12.9	01.9	73	72.2	10.7	133	131.6	19.5	193	190.9	22.3	253	250.2	37.1
14	13.8	02.1	74	73.2	10.8	134	132.5	19.6	194	191.9	22.5	254	251.2	37.3
15	14.8	02.2	75	74.2	11.0	135	133.5	19.8	195	192.9	22.6	255	252.2	37.4
16	15.8	02.3	76	75.2	11.1	136	134.5	19.9	196	193.9	22.7	256	253.2	37.5
17	16.8	02.5	77	76.2	11.2	137	135.5	20.1	197	194.9	22.9	257	254.2	37.7
18	17.8	02.6	78	77.1	11.4	138	136.5	20.2	198	195.8	22.9	258	255.2	37.8
19	18.8	02.8	79	78.1	11.6	139	137.5	20.4	199	196.8	22.9	259	256.2	38.0
20	19.8	02.9	80	79.1	11.7	140	138.5	20.5	200	197.8	22.9	260	257.2	38.1
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	22.9	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	142	140.5	20.8	202	199.8	22.9	262	259.1	38.4
23	22.7	03.4	83	82.1	12.2	143	141.4	21.0	203	200.8	22.9	263	260.1	38.6
24	23.7	03.5	84	83.1	12.3	144	142.4	21.1	204	201.8	22.9	264	261.1	38.7
25	24.7	03.7	85	84.1	12.5	145	143.4	21.3	205	202.8	23.0	265	262.1	38.9
26	25.7	03.8	86	85.1	12.6	146	144.4	21.4	206	203.8	23.0	266	263.1	39.0
27	26.7	04.0	87	86.1	12.8	147	145.4	21.6	207	204.7	23.0	267	264.1	39.2
28	27.7	04.1	88	87.0	12.9	148	146.4	21.7	208	205.7	23.0	268	265.1	39.3
29	28.7	04.3	89	88.0	13.0	149	147.4	21.8	209	206.7	23.0	269	266.1	39.5
30	29.7	04.4	90	89.0	13.2	150	148.4	22.0	210	207.7	23.0	270	267.1	39.6
31	30.7	04.5	91	90.0	13.3	151	149.4	22.1	211	208.7	23.0	271	268.1	39.7
32	31.7	04.7	92	91.0	13.5	152	150.3	22.3	212	209.7	23.1	272	269.0	39.9
33	32.6	04.8	93	92.0	13.6	153	151.3	22.4	213	210.7	23.1	273	270.0	40.0
34	33.6	05.0	94	93.0	13.8	154	152.3	22.6	214	211.7	23.1	274	271.0	40.2
35	34.6	05.1	95	94.0	13.9	155	153.3	22.7	215	212.7	23.1	275	272.0	40.3
36	35.6	05.3	96	95.0	14.1	156	154.3	22.9	216	213.7	23.1	276	273.0	40.5
37	36.6	05.4	97	95.9	14.2	157	155.3	23.0	217	214.6	23.1	277	274.0	40.6
38	37.6	05.6	98	96.9	14.4	158	156.3	23.2	218	215.6	23.0	278	275.0	40.8
39	38.6	05.7	99	97.9	14.5	159	157.3	23.3	219	216.6	23.1	279	276.0	40.9
40	39.6	05.9	100	98.9	14.7	160	158.3	23.5	220	217.6	23.2	280	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.2	23.6	221	218.6	23.2	281	277.9	41.2
42	41.5	06.2	102	100.9	15.0	162	160.2	23.8	222	219.6	23.2	282	278.9	41.4
43	42.5	06.3	103	101.9	15.1	163	161.2	23.9	223	220.6	23.2	283	279.9	41.5
44	43.5	06.5	104	102.9	15.3	164	162.2	24.0	224	221.6	23.2	284	280.9	41.6
45	44.5	06.6	105	103.9	15.4	165	163.2	24.2	225	222.6	23.0	285	281.9	41.8
46	45.5	06.7	106	104.8	15.5	166	164.2	24.3	226	223.5	23.1	286	282.9	41.9
47	46.5	6.9	107	105.8	15.7	167	165.2	24.5	227	224.5	23.3	287	283.9	42.1
48	47.5	07.0	108	106.8	15.8	168	166.2	24.6	228	225.5	23.4	288	284.9	42.2
49	48.5	07.2	109	107.8	16.0	169	167.2	24.8	229	226.5	23.6	289	285.9	42.4
50	49.5	07.3	110	108.8	16.1	170	168.1	24.9	230	227.5	23.7	290	286.9	42.5
51	50.4	07.5	111	109.8	16.3	171	169.1	25.1	231	228.5	23.9	291	287.8	42.7
52	51.4	07.6	112	110.8	16.4	172	170.1	25.2	232	229.5	24.0	292	288.8	42.8
53	52.4	07.8	113	111.8	16.6	173	171.1	25.4	233	230.5	24.2	293	289.8	43.0
54	53.4	07.9	114	112.8	16.7	174	172.1	25.5	234	231.5	24.3	294	290.8	43.1
55	54.4	08.1	115	113.7	16.9	175	173.1	25.7	235	232.4	24.5	295	291.8	43.3
56	55.4	08.2	116	114.7	17.0	176	174.1	25.8	236	233.4	24.6	296	292.8	43.4
57	56.4	08.4	117	115.7	17.2	177	175.1	26.0	237	234.4	24.8	297	293.8	43.6
58	57.4	08.5	118	116.7	17.3	178	176.1	26.1	238	235.4	24.9	298	294.8	43.7
59	58.4	08.6	119	117.7	17.5	179	177.1	26.3	239	236.4	25.0	299	295.8	43.8
60	59.3	08.8	120	118.7	17.6	180	178.0	26.4	240	237.4	25.2	300	296.8	44.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Difference of Latitude and Departure for 1 Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.3	47.0
2	02.0	00.4	62	60.8	12.1	22	119.6	23.8	82	178.5	35.5	42	237.3	47.2
3	03.0	00.6	63	61.8	12.3	23	120.6	24.0	83	179.5	35.7	43	238.3	47.4
4	04.0	00.8	64	62.8	12.5	24	121.6	24.2	84	180.4	35.9	44	239.3	47.6
5	05.0	01.0	65	63.7	12.7	25	122.6	24.4	85	181.4	36.1	45	240.3	47.8
6	06.0	01.2	66	64.7	12.9	26	123.6	24.6	86	182.4	36.3	46	241.2	48.0
7	07.0	01.4	67	65.7	13.1	27	124.5	24.8	87	183.4	36.5	47	242.2	48.2
8	08.0	01.6	68	66.7	13.3	28	125.5	25.0	88	184.4	36.7	48	243.2	48.4
9	09.0	01.8	69	67.7	13.5	29	126.5	25.2	89	185.3	36.9	49	244.2	48.6
10	10.0	02.0	70	68.6	13.7	30	127.5	25.4	90	186.3	37.1	50	245.2	48.8
11	10.8	02.1	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.1	49.0
12	11.8	02.3	72	70.6	14.0	32	129.5	25.8	02	188.3	37.5	52	247.1	49.2
13	12.7	02.5	73	71.6	14.2	33	130.4	26.0	03	189.3	37.7	53	248.1	49.4
14	13.7	02.7	74	72.6	14.4	34	131.4	26.1	04	190.2	37.9	54	249.1	49.6
15	14.7	02.9	75	73.6	14.6	35	132.4	26.3	05	191.2	38.0	55	250.1	49.8
16	15.7	03.1	76	74.5	14.8	36	133.4	26.5	06	192.2	38.2	56	251.1	50.0
17	16.7	03.3	77	75.5	15.0	37	134.4	26.7	07	193.2	38.4	57	252.1	50.1
18	17.7	03.5	78	76.5	15.2	38	135.3	26.9	08	194.2	38.6	58	253.0	50.3
19	18.6	03.7	79	77.5	15.4	39	136.3	27.1	09	195.2	38.8	59	254.0	50.5
20	19.6	03.9	80	78.5	15.6	40	137.3	27.3	200	196.1	39.0	60	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	42	139.3	27.7	02	198.1	39.4	62	256.9	51.1
23	22.6	04.5	83	81.4	16.2	43	140.2	27.9	03	199.1	39.6	63	257.9	51.3
24	23.5	04.7	84	82.4	16.4	44	141.2	28.1	04	200.1	39.8	64	258.9	51.5
25	24.5	04.9	85	83.4	16.6	45	142.2	28.3	05	201.0	40.0	65	259.9	51.7
26	25.5	05.1	86	84.3	16.8	46	143.2	28.5	06	202.0	40.2	66	260.9	51.9
27	26.5	05.3	87	85.3	17.0	47	144.2	28.7	07	203.0	40.4	67	261.8	52.1
28	27.5	05.5	88	86.3	17.2	48	145.1	28.9	08	204.0	40.6	68	262.8	52.3
29	28.4	05.7	89	87.3	17.4	49	146.1	29.1	09	205.0	40.8	69	263.8	52.5
30	29.4	05.9	90	88.3	17.6	50	147.1	29.3	10	205.9	41.0	70	264.8	52.7
31	30.4	06.0	91	89.2	17.8	151	148.1	29.5	211	206.9	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	18.0	52	149.1	29.7	12	207.9	41.4	72	266.7	53.1
33	32.4	06.4	93	91.2	18.1	53	150.0	29.9	13	208.9	41.6	73	267.7	53.3
34	33.3	06.6	94	92.2	18.3	54	151.0	30.0	14	209.9	41.8	74	268.7	53.5
35	34.3	06.8	95	93.2	18.5	55	152.0	30.2	15	210.8	42.0	75	269.7	53.7
36	35.3	07.0	96	94.1	18.7	56	153.0	30.4	16	211.8	42.1	76	270.7	53.9
37	36.3	07.2	97	95.1	18.9	57	154.0	30.6	17	212.8	42.3	77	271.6	54.0
38	37.3	07.4	98	96.1	19.1	58	154.9	30.8	18	213.8	42.5	78	272.6	54.2
39	38.2	07.6	99	97.1	19.3	59	155.9	31.0	19	214.8	42.7	79	273.6	54.4
40	39.2	07.8	100	98.1	19.5	60	156.9	31.2	20	215.7	42.9	80	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.7	43.1	281	275.6	54.8
42	41.2	08.2	02	100.0	19.9	62	158.9	31.6	22	217.7	43.3	82	276.5	55.0
43	42.2	08.4	03	101.0	20.1	63	159.8	31.8	23	218.7	43.5	83	277.5	55.2
44	43.2	08.6	04	102.0	20.3	64	160.8	32.0	24	219.7	43.7	84	278.5	55.4
45	44.1	08.8	05	103.0	20.5	65	161.8	32.2	25	220.6	43.9	85	279.5	55.6
46	45.1	09.0	06	104.0	20.7	66	162.8	32.4	26	221.6	44.1	86	280.5	55.8
47	46.1	09.2	07	104.9	20.9	67	163.8	32.6	27	222.6	44.3	87	281.5	56.0
48	47.1	09.4	08	105.9	21.1	68	164.7	32.8	28	223.6	44.5	88	282.4	56.2
49	48.1	09.6	09	106.9	21.3	69	165.7	33.0	29	224.6	44.7	89	283.4	56.4
50	49.0	09.8	10	107.9	21.5	70	166.7	33.2	30	225.6	44.9	90	284.4	56.6
51	50.0	10.0	111	108.9	21.7	171	167.7	33.4	231	226.5	45.1	291	285.4	56.8
52	51.0	10.1	12	109.8	21.9	72	168.7	33.6	32	227.5	45.3	92	286.4	57.0
53	52.0	10.3	13	110.8	22.0	73	169.7	33.8	33	228.5	45.5	93	287.3	57.2
54	53.0	10.5	14	111.8	22.2	74	170.6	34.0	34	229.5	45.6	94	288.3	57.4
55	53.9	10.7	15	112.8	22.4	75	171.6	34.1	35	230.5	45.9	95	289.3	57.6
56	54.9	10.9	16	113.8	22.6	76	172.6	34.3	36	231.4	46.0	96	290.3	57.8
57	55.9	11.1	17	114.7	22.8	77	173.6	34.5	37	232.4	46.2	97	291.3	58.0
58	56.9	11.3	18	115.7	23.0	78	174.6	34.7	38	233.4	46.4	98	292.2	58.1
59	57.9	11.5	19	116.7	23.2	79	175.5	34.9	39	234.4	46.6	99	293.2	58.3
60	58.8	11.7	120	117.7	23.4	80	176.5	35.1	40	235.4	46.8	300	294.2	58.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 7 Points

Difference of Latitude and Departure for 1 $\frac{1}{2}$ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	22	118.3	29.6	82	176.5	44.2	42	234.7	58.8
3	2.9	00.7	63	61.1	15.3	23	119.3	29.9	83	177.5	44.5	43	235.7	59.0
4	03.9	01.0	64	62.1	15.6	24	120.3	30.1	84	178.5	44.7	44	236.7	59.3
5	04.9	01.2	65	63.1	15.8	25	121.3	30.4	85	179.5	45.0	45	237.7	59.5
6	05.8	01.5	66	64.0	16.0	26	122.2	30.6	86	180.4	45.2	46	238.6	59.8
7	06.8	01.7	67	65.0	16.3	27	123.2	30.9	87	181.4	45.4	47	239.6	60.0
8	07.8	01.9	68	66.0	16.5	28	124.2	31.1	88	182.4	45.7	48	240.6	60.3
9	08.7	02.2	69	66.9	16.8	29	125.1	31.3	89	183.3	45.9	49	241.5	60.5
10	09.7	02.4	70	67.9	17.0	30	126.1	31.6	90	184.3	46.2	50	242.5	60.7
11	10.7	02.7	71	68.9	17.3	31	127.1	31.8	91	185.3	46.4	51	243.5	61.0
12	11.6	02.9	72	69.8	17.5	32	128.0	32.1	92	186.2	46.7	52	244.4	61.2
13	12.6	03.2	73	70.8	17.7	33	129.0	32.3	93	187.2	46.9	53	245.4	61.5
14	13.6	03.4	74	71.8	18.0	34	130.0	32.6	94	188.2	47.1	54	246.4	61.7
15	14.6	03.6	75	72.8	18.2	35	131.0	32.8	95	189.2	47.4	55	247.4	62.0
16	15.5	03.9	76	73.7	18.5	36	131.9	33.0	96	190.1	47.6	56	248.3	62.2
17	16.5	04.1	77	74.7	18.7	37	132.9	33.3	97	191.1	47.9	57	249.3	62.5
18	17.5	04.4	78	75.7	19.0	38	133.9	33.5	98	192.1	48.1	58	250.3	62.7
19	18.4	04.6	79	76.6	19.2	39	134.8	33.8	99	193.0	48.4	59	251.2	62.9
20	19.4	04.9	80	77.6	19.4	40	135.8	34.0	100	194.0	48.6	60	252.2	63.2
21	20.4	05.1	81	78.6	19.7	41	136.8	34.3	101	195.0	48.8	61	253.2	63.4
22	21.3	05.3	82	79.5	19.9	42	137.7	34.5	102	195.9	49.1	62	254.1	63.7
23	22.3	05.6	83	80.5	20.2	43	138.7	34.7	103	196.9	49.3	63	255.1	63.9
24	23.3	05.8	84	81.5	20.4	44	139.7	35.0	104	197.9	49.6	64	256.1	64.2
25	24.3	06.1	85	82.5	20.7	45	140.7	35.2	105	198.9	49.8	65	257.1	64.4
26	25.2	06.3	86	83.4	20.9	46	141.6	35.5	106	199.8	50.1	66	258.0	64.6
27	26.2	06.6	87	84.4	21.1	47	142.6	35.7	107	200.8	50.3	67	259.0	64.9
28	27.2	06.8	88	85.4	21.4	48	143.6	36.0	108	201.8	50.5	68	260.0	65.1
29	28.1	07.0	89	86.3	21.6	49	144.5	36.2	109	202.7	50.8	69	260.9	65.4
30	29.1	07.2	90	87.3	21.9	50	145.5	36.5	110	203.7	51.0	70	261.9	65.6
31	30.1	07.5	91	88.3	22.1	51	146.5	36.7	111	204.7	51.3	71	262.9	65.9
32	31.0	07.8	92	89.2	22.4	52	147.4	36.9	112	205.6	51.5	72	263.8	66.1
33	32.0	08.0	93	90.2	22.6	53	148.4	37.2	113	206.6	51.8	73	264.8	66.3
34	33.0	08.3	94	91.2	22.8	54	149.4	37.4	114	207.6	52.0	74	265.8	66.6
35	34.0	08.5	95	92.2	23.1	55	150.4	37.7	115	208.6	52.2	75	266.8	66.8
36	34.9	08.7	96	93.1	23.3	56	151.3	37.9	116	209.5	52.5	76	267.7	67.1
37	35.9	09.0	97	94.1	23.6	57	152.3	38.2	117	210.5	52.7	77	268.7	67.3
38	36.9	09.2	98	95.1	23.8	58	153.3	38.4	118	211.5	53.0	78	269.7	67.6
39	37.8	09.5	99	96.0	24.1	59	154.2	38.6	119	212.4	53.2	79	270.6	67.8
40	38.8	09.7	100	97.0	24.3	60	155.2	38.9	120	213.4	53.5	80	271.6	68.0
41	39.8	10.0	101	98.0	24.5	61	156.2	39.1	121	214.4	53.7	81	272.6	68.3
42	40.7	10.2	102	98.9	24.8	62	157.1	39.4	122	215.3	53.9	82	273.5	68.5
43	41.7	10.4	103	99.9	25.0	63	158.1	39.6	123	216.3	54.2	83	274.5	68.8
44	42.7	10.7	104	100.9	25.3	64	159.1	39.9	124	217.3	54.4	84	275.5	69.0
45	43.7	10.9	105	101.9	25.5	65	160.1	40.1	125	218.3	54.7	85	276.5	69.3
46	44.6	11.2	106	102.8	25.8	66	161.0	40.3	126	219.2	54.9	86	277.4	69.5
47	45.6	11.4	107	103.8	26.0	67	162.0	40.6	127	220.2	55.2	87	278.4	69.7
48	46.6	11.7	108	104.8	26.2	68	163.0	40.8	128	221.2	55.4	88	279.4	70.0
49	47.5	11.9	109	105.7	26.5	69	163.9	41.1	129	222.1	55.6	89	280.3	70.2
50	48.5	12.2	110	106.7	26.7	70	164.9	41.3	130	223.1	55.9	90	281.3	70.5
51	49.5	12.4	111	107.7	27.0	71	165.9	41.6	131	224.1	56.1	91	282.3	70.7
52	50.4	12.6	112	108.6	27.2	72	166.8	41.8	132	225.0	56.4	92	283.2	71.0
53	51.4	12.9	113	109.6	27.5	73	167.8	42.0	133	226.0	56.6	93	284.2	71.2
54	52.4	13.1	114	110.6	27.7	74	168.8	42.3	134	227.0	56.9	94	285.2	71.4
55	53.4	13.4	115	111.6	27.9	75	169.8	42.5	135	228.0	57.1	95	286.2	71.7
56	54.3	13.6	116	112.5	28.2	76	170.7	42.8	136	228.9	57.3	96	287.1	71.9
57	55.3	13.9	117	113.5	28.4	77	171.7	43.0	137	229.9	57.6	97	288.1	72.2
58	56.3	14.1	118	114.5	28.7	78	172.7	43.3	138	230.9	57.8	98	289.1	72.4
59	57.2	14.3	119	115.4	28.9	79	173.6	43.5	139	231.8	58.1	99	290.0	72.7
60	58.2	14.6	120	116.4	29.2	80	174.6	43.7	140	232.8	58.3	100	291.0	72.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 $\frac{3}{4}$ Points.

Difference of Latitude and Departure for 1 1/2 Point.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	69.9			
2	01.0	00.6	62	59.3	18.0	22	116.8	35.4	82	174.2	52.8	42	231.6	70.2			
3	02.0	00.9	63	60.3	18.3	23	117.7	35.7	83	175.1	53.1	43	232.5	70.5			
4	03.0	01.2	64	61.2	18.6	24	118.7	36.0	84	176.1	53.4	44	233.5	70.8			
5	04.0	01.5	65	62.2	18.9	25	119.6	36.3	85	177.0	53.7	45	234.5	71.0			
6	05.0	01.7	66	63.2	19.1	26	120.6	36.5	86	178.0	53.9	46	235.4	71.3			
7	06.0	02.0	67	64.1	19.4	27	121.5	36.8	87	179.0	54.2	47	236.4	71.6			
8	07.0	02.3	68	65.1	19.7	28	122.5	37.1	88	179.9	54.5	48	237.3	71.9			
9	08.0	02.6	69	66.0	20.0	29	123.5	37.4	89	180.9	54.8	49	238.3	72.2			
10	09.0	02.9	70	67.0	20.3	30	124.4	37.7	90	181.8	55.1	50	239.2	72.5			
11	10.0	03.2	71	67.9	20.6	31	125.4	38.0	91	182.8	55.4	51	240.2	72.8			
12	11.0	03.5	72	68.8	20.9	32	126.3	38.3	92	183.7	55.7	52	241.2	73.1			
13	12.0	03.8	73	69.9	21.2	33	127.3	38.6	93	184.7	56.0	53	242.1	73.4			
14	13.0	04.1	74	70.8	21.5	34	128.2	38.9	94	185.7	56.3	54	243.1	73.7			
15	14.0	04.4	75	71.8	21.8	35	129.2	39.2	95	186.6	56.6	55	244.0	74.0			
16	15.0	04.6	76	72.7	22.0	36	130.2	39.4	96	187.6	56.8	56	245.0	74.2			
17	16.0	04.9	77	73.7	22.3	37	131.1	39.7	97	188.5	57.1	57	245.9	74.5			
18	17.0	05.2	78	74.6	22.6	38	132.1	40.0	98	189.5	57.4	58	246.9	74.8			
19	18.0	05.5	79	75.6	22.9	39	133.0	40.3	99	190.4	57.7	59	247.9	75.1			
20	19.0	05.8	80	76.6	23.2	40	134.0	40.6	100	191.4	58.0	60	248.8	75.4			
21	20.0	06.1	81	77.5	23.5	41	134.9	40.9	201	192.4	58.3	61	249.8	75.7			
22	21.0	06.4	82	78.5	23.8	42	135.9	41.2	02	193.3	58.6	62	250.7	76.0			
23	22.0	06.7	83	79.4	24.1	43	136.9	41.5	03	194.3	58.9	63	251.7	76.3			
24	23.0	07.0	84	80.4	24.4	44	137.8	41.8	04	195.2	59.2	64	252.6	76.6			
25	23.9	07.3	85	81.3	24.7	45	138.8	42.1	05	196.2	59.5	65	253.6	76.9			
26	24.9	07.5	86	82.3	24.9	46	139.7	42.3	06	197.1	59.7	66	254.6	77.1			
27	25.8	07.8	87	83.3	25.2	47	140.7	42.6	07	198.1	60.0	67	255.5	77.4			
28	26.8	08.1	88	84.2	25.5	48	141.6	42.9	08	199.1	60.3	68	256.5	77.7			
29	27.8	08.4	89	85.2	25.8	49	142.6	43.2	09	200.0	60.6	69	257.4	78.0			
30	28.7	08.7	90	86.1	26.1	50	143.5	43.5	10	201.0	60.9	70	258.4	78.3			
31	29.7	09.0	91	87.1	26.4	51	144.5	43.8	211	201.9	61.2	71	259.3	78.6			
32	30.6	09.3	92	88.0	26.7	52	145.5	44.1	12	202.9	61.5	72	260.3	78.9			
33	31.6	09.6	93	89.0	27.0	53	146.4	44.4	13	203.8	61.8	73	261.3	79.2			
34	32.5	09.9	94	90.0	27.3	54	147.4	44.7	14	204.8	62.1	74	262.2	79.5			
35	33.5	10.2	95	90.9	27.6	55	148.3	45.0	15	205.8	62.4	75	263.2	79.8			
36	34.5	10.4	96	91.9	27.8	56	149.3	45.2	16	206.7	62.6	76	264.1	80.0			
37	35.4	10.7	97	92.8	28.1	57	150.2	45.5	17	207.7	62.9	77	265.1	80.3			
38	36.4	11.0	98	93.8	28.4	58	151.2	45.8	18	208.6	63.2	78	266.0	80.6			
39	37.3	11.3	99	94.7	28.7	59	152.2	46.1	19	209.6	63.5	79	267.0	80.9			
40	38.3	11.6	100	95.7	29.0	60	153.1	46.4	20	210.5	63.8	80	268.0	81.2			
41	39.2	11.9	101	96.7	29.3	61	154.1	46.7	211	211.5	64.1	281	268.9	81.5			
42	40.2	12.2	02	97.6	29.6	62	155.0	47.0	22	212.5	64.4	82	269.9	81.8			
43	41.2	12.5	03	98.6	29.9	63	156.0	47.3	23	213.4	64.7	83	270.8	82.1			
44	42.1	12.8	04	99.5	30.2	64	156.9	47.6	24	214.4	65.0	84	271.8	82.4			
45	43.1	13.1	05	100.5	30.5	65	157.9	47.9	25	215.3	65.3	85	272.7	82.7			
46	44.0	13.3	06	101.4	30.7	66	158.9	48.1	26	216.3	65.5	86	273.7	82.9			
47	45.0	13.6	07	102.4	31.0	67	159.8	48.4	27	217.2	65.8	87	274.7	83.2			
48	45.9	13.9	08	103.4	31.3	68	160.8	48.7	28	218.2	66.1	88	275.6	83.5			
49	46.9	14.2	09	104.3	31.6	69	161.7	49.0	29	219.2	66.4	89	276.6	83.8			
50	47.9	14.5	10	105.3	31.9	70	162.7	49.3	30	220.1	66.7	90	277.5	84.1			
51	48.8	14.8	11	106.2	32.2	71	163.6	49.6	231	221.1	67.0	291	278.5	84.4			
52	49.8	15.1	12	107.2	32.5	72	164.6	49.9	32	222.0	67.3	92	279.4	84.7			
53	50.7	15.4	13	108.1	32.8	73	165.6	50.2	33	223.0	67.6	93	280.4	85.0			
54	51.7	15.7	14	109.1	33.1	74	166.5	50.5	34	223.9	67.9	94	281.4	85.3			
55	52.6	16.0	15	110.1	33.4	75	167.5	50.8	35	224.9	68.2	95	282.3	85.6			
56	53.6	16.2	16	111.0	33.6	76	168.4	51.0	36	225.9	68.4	96	283.3	85.8			
57	54.5	16.5	17	112.0	33.9	77	169.4	51.3	37	226.8	68.7	97	284.2	86.1			
58	55.5	16.8	18	112.9	34.2	78	170.3	51.6	38	227.8	69.0	98	285.2	86.4			
59	56.5	17.1	19	113.9	34.5	79	171.3	51.9	39	228.7	69.3	99	286.1	86.7			
60	57.4	17.4	20	114.8	34.8	80	172.3	52.2	40	229.7	69.6	100	287.1	87.0			
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 6 1/2 Points.

Difference of Latitude and Departure for 1 $\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.3	61	57.4	20.5	121	113.9	40.8	181	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	122	114.9	41.1	182	171.4	61.3	242	227.8	81.5
3	02.8	01.0	63	59.3	21.2	123	115.8	41.4	183	172.3	61.6	243	228.8	81.8
4	03.8	01.3	64	60.3	21.6	124	116.7	41.8	184	173.2	62.0	244	229.7	82.2
5	04.7	01.7	65	61.2	21.9	125	117.7	42.1	185	174.2	62.3	245	230.7	82.5
6	05.6	02.0	66	62.1	22.2	126	118.6	42.4	186	175.1	62.6	246	231.6	82.9
7	06.6	02.4	67	63.1	22.6	127	119.6	42.8	187	176.1	63.0	247	232.5	83.2
8	07.5	02.7	68	64.0	22.9	128	120.5	43.1	188	177.0	63.3	248	233.5	83.5
9	08.5	03.0	69	65.0	23.2	129	121.5	43.4	189	177.9	63.7	249	234.4	83.9
10	09.4	03.4	70	65.9	23.6	130	122.4	43.8	190	178.9	64.0	250	235.4	84.2
11	10.4	03.7	71	66.8	23.9	131	123.3	44.1	191	179.8	64.3	251	236.3	84.5
12	11.3	04.0	72	67.8	24.2	132	124.3	44.5	192	180.8	64.7	252	237.3	84.9
13	12.2	04.4	73	68.8	24.6	133	125.2	44.8	193	181.7	65.0	253	238.2	85.2
14	13.2	04.7	74	69.7	24.9	134	126.2	45.1	194	182.6	65.3	254	239.1	85.5
15	14.1	05.1	75	70.6	25.3	135	127.1	45.5	195	183.6	65.7	255	240.1	85.9
16	15.1	05.4	76	71.6	25.6	136	128.0	45.8	196	184.5	66.0	256	241.0	86.2
17	16.0	05.7	77	72.5	25.9	137	129.0	46.1	197	185.5	66.3	257	242.0	86.6
18	17.0	06.1	78	73.4	26.3	138	129.9	46.5	198	186.4	66.7	258	242.9	86.9
19	17.9	06.4	79	74.4	26.6	139	130.9	46.8	199	187.4	67.0	259	243.8	87.2
20	18.8	06.7	80	75.3	26.9	140	131.8	47.2	200	188.3	67.4	260	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.2	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	142	133.7	47.8	202	190.2	68.0	262	246.7	88.2
23	21.7	07.7	83	78.1	28.0	143	134.6	48.2	203	191.1	68.4	263	247.6	88.6
24	22.6	08.1	84	79.1	28.3	144	135.6	48.5	204	192.1	68.7	264	248.6	88.9
25	23.5	08.4	85	80.0	28.6	145	136.5	48.8	205	193.0	69.0	265	249.5	89.2
26	24.5	08.8	86	81.0	29.0	146	137.5	49.2	206	194.0	69.4	266	250.4	89.6
27	25.4	09.1	87	81.9	29.3	147	138.4	49.5	207	194.9	69.7	267	251.4	89.9
28	26.4	09.4	88	82.8	29.6	148	139.3	49.8	208	195.8	70.1	268	252.3	90.3
29	27.3	09.8	89	83.8	30.0	149	140.3	50.2	209	196.8	70.4	269	253.3	90.6
30	28.2	10.1	90	84.7	30.3	150	141.2	50.5	210	197.7	70.7	270	254.2	90.9
31	29.2	10.4	91	85.7	30.6	151	142.2	50.9	211	198.7	71.1	271	255.1	91.3
32	30.1	10.8	92	86.6	31.0	152	143.1	51.2	212	199.6	71.4	272	256.1	91.6
33	31.1	11.1	93	87.6	31.3	153	144.0	51.5	213	200.5	71.7	273	257.0	91.9
34	32.0	11.5	94	88.5	31.7	154	145.0	51.9	214	201.5	72.1	274	258.0	92.3
35	33.0	11.8	95	89.4	32.0	155	145.9	52.2	215	202.4	72.4	275	258.9	92.6
36	33.9	12.1	96	90.4	32.3	156	146.9	52.5	216	203.4	72.7	276	259.9	93.0
37	34.8	12.5	97	91.3	32.7	157	147.8	52.9	217	204.3	73.1	277	260.8	93.3
38	35.8	12.8	98	92.3	33.0	158	148.8	53.2	218	205.2	73.4	278	261.7	93.6
39	36.7	13.1	99	93.2	33.3	159	149.7	53.6	219	206.2	73.8	279	262.7	94.0
40	37.7	13.5	100	94.2	33.7	160	150.6	53.0	220	207.1	74.1	280	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.4	281	264.6	94.6
42	39.5	14.1	102	96.0	34.4	162	152.5	54.6	222	209.0	74.8	282	265.5	95.0
43	40.5	14.5	103	97.0	34.7	163	153.5	54.9	223	210.0	75.1	283	266.4	95.3
44	41.4	14.8	104	97.9	35.0	164	154.4	55.2	224	210.9	75.4	284	267.4	95.6
45	42.4	15.2	105	98.9	35.4	165	155.3	55.6	225	211.8	75.8	285	268.3	96.0
46	43.3	15.5	106	99.7	35.7	166	156.3	55.9	226	212.8	76.1	286	269.3	96.3
47	44.3	15.8	107	100.8	36.0	167	157.2	56.2	227	213.7	76.5	287	270.2	96.7
48	45.2	16.2	108	101.7	36.4	168	158.2	56.6	228	214.7	76.8	288	271.2	97.0
49	46.1	16.5	109	102.7	36.7	169	159.1	56.9	229	215.6	77.1	289	272.1	97.3
50	47.1	16.8	110	103.6	37.0	170	160.1	57.3	230	216.5	77.5	290	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	112	105.4	37.7	172	161.9	57.9	232	218.4	78.1	292	274.9	98.3
53	49.9	17.9	113	106.4	38.1	173	162.9	58.4	233	219.4	78.5	293	275.9	98.7
54	50.8	18.2	114	107.3	38.4	174	163.8	58.6	234	220.3	78.8	294	276.8	99.0
55	51.8	18.5	115	108.3	38.7	175	164.8	58.9	235	221.3	79.1	295	277.7	99.4
56	52.7	18.9	116	109.2	39.1	176	165.7	59.3	236	222.2	79.5	296	278.7	99.7
57	53.7	19.2	117	110.2	39.4	177	166.6	59.6	237	223.1	79.8	297	279.6	100.0
58	54.6	19.5	118	111.1	39.7	178	167.6	60.0	238	224.1	80.2	298	280.6	100.4
59	55.5	19.9	119	112.0	40.1	179	168.5	60.3	239	225.0	80.5	299	281.5	100.7
60	56.5	20.2	120	113.0	40.4	180	169.5	60.6	240	226.0	80.8	300	282.5	101.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 6 $\frac{1}{4}$ Points.

Difference of Latitude and Departure for 2 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.4	23.3	121	111.8	46.3	181	167.2	69.3	241	222.7	92.2
2	01.8	00.8	62	57.3	23.7	122	112.7	46.7	82	168.2	69.7	42	223.6	92.6
3	02.8	01.1	63	58.2	24.1	123	113.6	47.1	83	169.1	70.0	43	224.5	93.0
4	03.7	01.5	64	59.1	24.5	124	114.6	47.5	84	170.0	70.4	44	225.4	93.4
5	04.6	01.9	65	60.1	24.9	125	115.5	47.8	85	170.9	70.8	45	226.4	93.8
6	05.5	02.3	66	61.0	25.3	126	116.4	48.2	86	171.9	71.2	46	227.3	94.1
7	06.5	02.7	67	61.9	25.6	127	117.3	48.6	87	172.8	71.6	47	228.2	94.5
8	07.4	03.1	68	62.8	26.0	128	118.3	49.0	88	173.7	72.0	48	229.1	94.9
9	08.3	03.4	69	63.8	26.4	129	119.2	49.4	89	174.6	72.3	49	230.1	95.3
10	09.2	03.8	70	64.7	26.8	130	120.1	49.8	90	175.6	72.7	50	231.0	95.7
11	10.0	04.2	71	65.6	27.2	131	121.0	50.1	191	176.5	73.1	251	231.9	96.1
12	11.1	04.6	72	66.5	27.6	132	122.0	50.5	92	177.4	73.5	52	232.8	96.4
13	12.0	05.0	73	67.5	27.9	133	122.9	50.9	93	178.3	73.9	53	233.8	96.8
14	12.9	05.4	74	68.4	28.3	134	123.8	51.3	94	179.2	74.2	54	234.7	97.2
15	13.9	05.7	75	69.3	28.7	135	124.7	51.7	95	180.2	74.6	55	235.6	97.6
16	14.8	06.1	76	70.2	29.1	136	125.7	52.0	96	181.1	75.0	56	236.5	98.0
17	15.7	06.5	77	71.1	29.5	137	126.6	52.4	97	182.0	75.4	57	237.5	98.4
18	16.6	06.9	78	72.1	29.9	138	127.5	52.8	98	182.9	75.8	58	238.4	98.7
19	17.6	07.3	79	73.0	30.2	139	128.4	53.2	99	183.9	76.2	59	239.3	99.1
20	18.5	07.7	80	73.9	30.6	140	129.4	53.6	200	184.8	76.5	60	240.2	99.5
21	19.4	08.0	81	74.8	31.0	141	130.3	54.0	201	185.7	76.9	261	241.1	99.9
22	20.3	08.4	82	75.8	31.4	142	131.2	54.3	02	186.6	77.3	62	242.1	100.3
23	21.3	08.8	83	76.7	31.8	143	132.1	54.7	03	187.6	77.7	63	243.0	100.7
24	22.2	09.2	84	77.6	32.1	144	133.0	55.1	04	188.5	78.1	64	243.9	101.0
25	23.1	09.6	85	78.5	32.5	145	134.0	55.5	05	189.4	78.5	65	244.8	101.4
26	24.0	10.0	86	79.5	32.9	146	134.9	55.9	06	190.3	78.8	66	245.8	101.8
27	24.9	10.3	87	80.4	33.3	147	135.8	56.3	07	191.3	79.2	67	246.7	102.2
28	25.9	10.7	88	81.3	33.7	148	136.7	56.6	08	192.2	79.6	68	247.6	102.6
29	26.8	11.1	89	82.2	34.1	149	137.7	57.0	09	193.1	80.0	69	248.5	103.0
30	27.7	11.5	90	83.2	34.4	150	138.6	57.4	10	194.0	80.4	70	249.5	103.3
31	28.6	11.9	91	84.1	34.8	151	139.5	57.8	211	194.9	80.8	271	250.4	103.7
32	29.6	12.2	92	85.0	35.2	152	140.4	58.2	12	195.9	81.1	72	251.3	104.1
33	30.5	12.6	93	85.9	35.6	153	141.4	58.6	13	196.8	81.5	73	252.2	104.5
34	31.4	13.0	94	86.9	36.0	154	142.3	58.9	14	197.7	81.9	74	253.2	104.9
35	32.3	13.4	95	87.8	36.4	155	143.2	59.3	15	198.6	82.3	75	254.1	105.2
36	33.3	13.8	96	88.7	36.7	156	144.1	59.7	16	199.6	82.7	76	255.0	105.6
37	34.2	14.2	97	89.6	37.1	157	145.1	60.1	17	200.5	83.0	77	255.9	106.0
38	35.1	14.5	98	90.6	37.5	158	146.0	60.5	18	201.4	83.4	78	256.9	106.4
39	36.0	14.9	99	91.5	37.9	159	146.9	60.9	19	202.3	83.8	79	257.8	106.8
40	37.0	15.3	100	92.4	38.3	160	147.8	61.2	20	203.3	84.2	80	258.7	107.2
41	37.9	15.7	101	93.3	38.7	161	148.8	61.6	221	204.2	84.6	281	259.6	107.5
42	38.8	16.1	02	94.2	39.0	162	149.7	62.0	22	205.1	85.0	82	260.6	107.9
43	39.7	16.5	03	95.1	39.4	163	150.6	62.4	23	206.0	85.3	83	261.5	108.3
44	40.6	16.8	04	96.1	39.8	164	151.5	62.8	24	207.0	85.7	84	262.4	108.7
45	41.6	17.2	05	97.0	40.2	165	152.5	63.1	25	207.9	86.1	85	263.3	109.1
46	42.5	17.6	06	97.9	40.6	166	153.4	63.5	26	208.8	86.5	86	264.2	109.5
47	43.4	18.0	07	98.9	41.0	167	154.3	63.9	27	209.7	86.9	87	265.2	109.8
48	44.4	18.4	08	99.8	41.3	168	155.2	64.3	28	210.7	87.3	88	266.1	110.2
49	45.3	18.8	09	100.7	41.7	169	156.1	64.7	29	211.6	87.6	89	267.0	110.6
50	46.2	19.1	10	101.6	42.1	170	157.1	65.1	30	212.5	88.0	90	267.9	111.0
51	47.1	19.5	111	102.6	42.5	171	158.0	65.4	231	213.4	88.4	291	268.9	111.4
52	48.0	19.9	12	103.5	42.9	172	158.9	65.8	32	214.4	88.8	92	269.8	111.8
53	49.0	20.3	13	104.4	43.2	173	159.8	66.2	33	215.3	89.2	93	270.7	112.1
54	49.9	20.7	14	105.3	43.6	174	160.8	66.6	34	216.2	89.6	94	271.6	112.5
55	50.8	21.0	15	106.3	44.0	175	161.7	67.0	35	217.1	89.9	95	272.6	112.9
56	51.7	21.4	16	107.2	44.4	176	162.6	67.4	36	218.0	90.3	96	273.5	113.3
57	52.7	21.8	17	108.1	44.8	177	163.5	67.7	37	219.0	90.7	97	274.4	113.7
58	53.6	22.2	18	109.0	45.2	178	164.5	68.1	38	219.9	91.1	98	275.3	114.0
59	54.5	22.6	19	109.9	45.5	179	165.4	68.5	39	220.8	91.5	99	276.3	114.4
60	55.4	23.0	20	110.9	45.9	180	166.3	68.9	40	221.7	91.9	300	277.2	114.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 6 Points.

Difference of Latitude and Departure for 2 1/4 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.8	103.0
2	01.8	00.9	62	56.0	26.5	22	110.3	52.2	82	164.5	77.8	42	218.7	103.5
3	02.7	01.3	63	57.0	26.9	23	111.2	52.6	83	165.4	78.2	43	219.6	103.9
4	03.6	01.7	64	57.9	27.4	24	112.1	53.0	84	166.3	78.7	44	220.5	104.3
5	04.5	02.1	65	58.8	27.8	25	113.0	53.5	85	167.2	79.1	45	221.4	104.8
6	05.4	02.6	66	59.7	28.2	26	113.9	53.9	86	168.1	79.5	46	222.4	105.2
7	06.3	03.0	67	60.6	28.6	27	114.8	54.3	87	169.0	80.0	47	223.3	105.6
8	07.2	03.4	68	61.5	29.1	28	115.7	54.7	88	169.9	80.4	48	224.2	106.0
9	08.1	03.8	69	62.4	29.5	29	116.6	55.2	89	170.8	80.8	49	225.1	106.5
10	09.0	04.3	70	63.3	29.9	30	117.5	55.6	90	171.7	81.2	50	226.0	106.9
11	09.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.6	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	32	119.3	56.4	92	173.6	82.1	52	227.8	107.8
13	11.8	05.6	73	66.0	31.2	33	120.2	56.9	93	174.5	82.5	53	228.7	108.2
14	12.7	06.0	74	66.9	31.6	34	121.1	57.3	94	175.4	83.0	54	229.6	108.6
15	13.6	06.4	75	67.8	32.1	35	122.0	57.7	95	176.3	83.4	55	230.5	109.0
16	14.5	06.8	76	68.7	32.5	36	122.9	58.2	96	177.2	83.8	56	231.4	109.5
17	15.4	07.3	77	69.6	32.9	37	123.8	58.6	97	178.1	84.2	57	232.3	109.9
18	16.3	07.7	78	70.5	33.4	38	124.7	59.0	98	179.0	84.7	58	233.2	110.3
19	17.2	08.1	79	71.4	33.8	39	125.6	59.4	99	179.9	85.1	59	234.1	110.7
20	18.1	08.6	80	72.3	34.2	40	126.5	59.9	200	180.8	85.5	60	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.4	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	42	128.4	60.7	02	182.6	86.4	62	236.8	112.0
23	20.8	09.8	83	75.0	35.5	43	129.3	61.1	03	183.5	86.8	63	237.7	112.5
24	21.7	10.3	84	75.9	35.9	44	130.2	61.6	04	184.4	87.2	64	238.6	112.9
25	22.6	10.7	85	76.8	36.3	45	131.1	62.0	05	185.3	87.7	65	239.5	113.3
26	23.5	11.1	86	77.7	36.8	46	132.0	62.4	06	186.2	88.1	66	240.4	113.7
27	24.4	11.5	87	78.6	37.2	47	132.9	62.9	07	187.1	88.5	67	241.3	114.2
28	25.3	12.0	88	79.6	37.6	48	133.8	63.3	08	188.0	88.9	68	242.2	114.6
29	26.2	12.4	89	80.5	38.1	49	134.7	63.7	09	188.9	89.4	69	243.1	115.0
30	27.1	12.8	90	81.4	38.5	50	135.6	64.1	10	189.8	89.8	70	244.0	115.5
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	52	137.4	65.0	12	191.6	90.6	72	245.9	116.3
33	29.8	14.1	93	84.1	39.8	53	138.3	65.4	13	192.5	91.1	73	246.8	116.7
34	30.7	14.5	94	85.0	40.2	54	139.2	65.8	14	193.4	91.5	74	247.7	117.2
35	31.6	15.0	95	85.9	40.6	55	140.1	66.3	15	194.3	91.9	75	248.6	117.6
36	32.5	15.4	96	86.8	41.0	56	141.0	66.7	16	195.2	92.4	76	249.5	118.0
37	33.4	15.8	97	87.7	41.5	57	141.9	67.1	17	196.1	92.8	77	250.4	118.4
38	34.4	16.2	98	88.6	41.9	58	142.8	67.6	18	197.0	93.2	78	251.3	118.9
39	35.3	16.7	99	89.5	42.3	59	143.7	68.0	19	197.9	93.6	79	252.2	119.3
40	36.2	17.1	100	90.4	42.8	60	144.6	68.4	20	198.8	94.1	80	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.2
42	38.0	18.0	02	92.2	43.6	62	146.4	69.3	22	200.7	94.9	82	254.9	120.6
43	38.9	18.4	03	93.1	44.0	63	147.3	69.7	23	201.6	95.4	83	255.8	121.0
44	39.8	18.8	04	94.0	44.5	64	148.2	70.1	24	202.5	95.8	84	256.7	121.4
45	40.7	19.2	05	94.9	44.9	65	149.1	70.6	25	203.4	96.2	85	257.6	121.9
46	41.6	19.7	06	95.8	45.3	66	150.0	71.0	26	204.3	96.6	86	258.5	122.3
47	42.5	20.1	07	96.7	45.8	67	151.0	71.4	27	205.2	97.1	87	259.4	122.7
48	43.4	20.5	08	97.6	46.2	68	151.9	71.8	28	206.1	97.5	88	260.3	123.1
49	44.3	21.0	09	98.5	46.6	69	152.8	72.3	29	207.0	97.9	89	261.2	123.6
50	45.2	21.4	10	99.4	47.0	70	153.7	72.7	30	207.9	98.3	90	262.1	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.0	124.4
52	47.0	22.2	12	101.2	47.9	72	155.5	73.5	32	209.7	99.1	92	263.9	124.9
53	47.9	22.7	13	102.1	48.3	73	156.4	74.0	33	210.6	99.6	93	264.8	125.3
54	48.8	23.1	14	103.0	48.7	74	157.3	74.4	34	211.5	100.1	94	265.7	125.7
55	49.7	23.5	15	103.9	49.2	75	158.2	74.8	35	212.4	100.5	95	266.6	126.1
56	50.6	23.9	16	104.8	49.6	76	159.1	75.3	36	213.3	100.9	96	267.5	126.6
57	51.5	24.4	17	105.8	50.0	77	160.0	75.7	37	214.2	101.3	97	268.4	127.0
58	52.4	24.8	18	106.7	50.5	78	160.9	76.1	38	215.1	101.8	98	269.4	127.4
59	53.3	25.2	19	107.6	50.9	79	161.8	76.5	39	216.0	102.2	99	270.3	127.8
60	54.2	25.7	20	108.5	51.3	80	162.7	77.0	40	216.9	102.6	100	271.2	128.3
Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.

B b

for 7 1/4 Points.

Difference of Latitude and Departure for $2\frac{1}{2}$ Points.

Dist	Lat	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.8	28.7	121	106.7	57.0	181	159.6	85.3	241	212.6	113.5
2	01.8	00.9	62	54.7	29.2	22	107.6	57.5	82	160.5	85.8	42	213.4	114.0
3	02.6	01.4	63	55.6	29.7	23	108.5	58.0	83	161.4	86.2	43	214.3	114.5
4	03.5	01.9	64	56.4	30.2	24	109.4	58.4	84	162.3	86.7	44	215.2	115.0
5	04.4	02.4	65	57.3	30.6	25	110.3	58.9	85	163.2	87.2	45	216.1	115.4
6	05.3	02.8	66	58.2	31.1	26	111.0	59.4	86	164.1	87.6	46	217.0	115.9
7	06.2	03.3	67	59.1	31.6	27	112.1	59.8	87	164.9	88.1	47	217.9	116.4
8	07.1	03.8	68	60.0	32.0	28	112.9	60.3	88	165.8	88.6	48	218.7	116.8
9	07.9	04.2	69	60.9	32.5	29	113.8	60.8	89	166.7	89.1	49	219.6	117.3
10	08.8	04.7	70	61.7	33.0	30	114.7	61.3	90	167.6	89.5	50	220.5	117.8
11	09.7	05.2	71	62.6	33.5	31	115.5	61.7	191	168.5	90.0	51	221.4	118.3
12	10.6	05.7	72	63.5	33.9	32	116.4	62.2	2	169.3	90.5	52	222.3	118.7
13	11.5	06.1	73	64.4	34.4	33	117.3	62.7	93	170.2	90.9	53	223.1	119.2
14	12.3	06.6	74	65.3	34.9	34	118.2	63.1	94	171.1	91.4	54	224.0	119.7
15	13.2	07.1	75	66.2	35.3	35	119.1	63.6	95	172.0	91.9	55	224.9	120.1
16	14.2	07.5	76	67.0	35.8	36	120.0	64.1	96	172.9	92.4	56	225.8	120.6
17	15.0	08.0	77	67.9	36.3	37	120.8	64.5	97	173.8	92.8	57	226.7	121.1
18	15.9	08.5	78	68.8	36.8	38	121.7	65.0	98	174.6	93.3	58	227.6	121.6
19	16.8	09.0	79	69.7	37.2	39	122.6	65.5	99	175.5	93.8	59	228.4	122.0
20	17.6	09.4	80	70.6	37.7	40	123.5	66.0	200	176.4	94.2	60	229.3	122.5
21	18.5	09.9	81	71.4	38.2	141	124.4	66.4	201	177.3	94.7	261	230.2	123.0
22	19.4	10.4	82	72.3	38.6	42	125.2	66.9	2	178.2	95.2	62	231.1	123.4
23	20.3	10.8	83	73.2	39.1	43	126.1	67.4	93	179.0	95.6	63	232.0	123.9
24	21.2	11.3	84	74.1	39.6	44	127.0	67.8	94	179.9	96.1	64	232.8	124.4
25	22.1	11.8	85	75.0	40.1	45	127.9	68.3	95	180.8	96.6	65	233.7	124.9
26	22.9	12.3	86	75.9	40.5	46	128.8	68.8	96	181.7	97.1	66	234.6	125.3
27	23.8	12.7	87	76.7	41.0	47	129.6	69.3	97	182.6	97.5	67	235.5	125.8
28	24.7	13.2	88	77.6	41.5	48	130.5	69.7	98	183.5	98.0	68	236.4	126.3
29	25.6	13.7	89	78.5	41.9	49	131.4	70.2	99	184.3	98.5	69	237.3	126.7
30	26.5	14.1	90	79.4	42.4	50	132.3	70.7	10	185.2	98.9	70	238.1	127.2
31	27.3	14.6	91	80.3	42.9	151	133.2	71.1	211	186.1	99.4	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	52	134.1	71.6	12	187.0	99.9	72	239.9	128.2
33	29.1	15.5	93	82.0	43.8	53	134.9	72.1	13	187.9	100.4	73	240.8	128.6
34	30.0	16.0	94	82.9	44.3	54	135.8	72.6	14	188.7	100.8	74	241.7	129.1
35	30.9	16.5	95	83.8	44.8	55	136.7	73.0	15	189.6	101.3	75	242.5	129.6
36	31.8	17.0	96	84.7	45.2	56	137.6	73.5	16	190.5	101.8	76	243.4	130.0
37	32.6	17.4	97	85.6	45.7	57	138.5	74.0	17	191.4	102.2	77	244.3	130.5
38	33.5	17.9	98	86.4	46.2	58	139.4	74.4	18	192.3	102.7	78	245.2	131.0
39	34.4	18.4	99	87.3	46.6	59	140.2	74.9	19	193.2	103.2	79	246.1	131.5
40	35.3	18.8	100	88.2	47.1	60	141.1	75.4	20	194.0	103.7	80	247.0	131.9
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.1	281	247.8	132.4
42	37.0	19.8	102	90.0	48.1	62	142.9	76.3	22	195.8	104.6	82	248.7	132.9
43	37.9	20.3	103	90.8	48.5	63	143.8	76.8	23	196.7	105.1	83	249.6	133.3
44	38.8	20.7	104	91.7	49.0	64	144.6	77.3	24	197.6	105.5	84	250.5	133.8
45	39.7	21.2	105	92.6	49.5	65	145.5	77.7	25	198.4	106.0	85	251.4	134.3
46	40.6	21.7	106	93.5	49.9	66	146.4	78.2	26	199.3	106.5	86	252.3	134.8
47	41.5	22.1	107	94.4	50.4	67	147.3	78.7	27	200.2	107.0	87	253.1	135.2
48	42.3	22.6	108	95.3	50.9	68	148.2	79.2	28	201.1	107.4	88	254.0	135.7
49	43.2	23.1	109	96.1	51.4	69	149.1	79.6	29	202.0	107.9	89	254.9	136.2
50	44.1	23.6	110	97.0	51.8	70	149.9	80.1	30	202.9	108.4	90	255.8	136.6
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.8	291	256.7	137.1
52	45.9	24.5	112	98.8	52.8	72	151.7	81.0	32	204.6	109.3	92	257.5	137.6
53	46.7	25.0	113	99.7	53.2	73	152.6	81.5	33	205.5	109.8	93	258.4	138.1
54	47.6	25.4	114	100.5	53.7	74	153.5	82.0	34	206.4	110.3	94	259.3	138.5
55	48.5	25.9	115	101.4	54.2	75	154.3	82.5	35	207.3	110.7	95	260.2	139.0
56	49.4	26.4	116	102.3	54.7	76	155.2	82.9	36	208.2	111.2	96	261.1	139.5
57	50.3	26.9	117	103.2	55.1	77	156.1	83.4	37	209.0	111.7	97	262.0	139.9
58	51.2	27.3	118	104.1	55.6	78	157.0	83.9	38	209.9	112.1	98	262.8	140.4
59	52.0	27.8	119	105.0	56.1	79	157.9	84.3	39	210.8	112.6	99	263.7	140.9
60	52.9	28.3	120	105.8	56.5	80	158.8	84.8	40	211.7	113.1	300	264.6	141.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for $5\frac{1}{2}$ Points.

Difference of Latitude and Departure for 2 $\frac{3}{4}$ Points

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.9	00.6	61	52.3	31.4	121	103.8	62.2	181	155.2	93.0	241	206.7	123.9			
2	01.7	01.0	62	53.2	31.9	22	104.6	62.7	82	156.1	93.5	42	207.6	124.4			
3	02.6	01.5	63	54.0	32.4	23	105.5	63.2	83	157.0	94.0	43	208.4	124.9			
4	03.4	02.1	64	54.9	32.9	24	106.4	63.7	84	157.8	94.6	44	209.3	125.4			
5	04.3	02.6	65	55.8	33.4	25	107.2	64.2	85	158.7	95.1	45	210.1	125.9			
6	05.1	03.1	66	56.6	33.9	26	108.1	64.8	86	159.5	95.6	46	211.0	126.4			
7	06.0	03.6	67	57.5	34.4	27	108.9	65.3	87	160.4	96.1	47	211.9	126.9			
8	06.9	04.1	68	58.3	35.0	28	109.8	65.8	88	161.2	96.6	48	212.7	127.4			
9	07.7	04.6	69	59.2	35.5	29	110.6	66.3	89	162.1	97.1	49	213.6	128.0			
10	08.6	05.1	70	60.0	36.0	30	111.5	66.8	90	163.0	97.6	50	214.4	128.5			
11	09.4	05.7	71	60.9	36.5	31	112.4	67.3	191	163.8	98.2	251	215.3	129.0			
12	10.3	06.2	72	61.8	37.0	32	113.2	67.8	92	164.7	98.7	52	216.1	129.5			
13	11.2	06.7	73	62.6	37.6	33	114.1	68.4	93	165.5	99.2	53	217.0	130.0			
14	12.0	07.2	74	63.5	38.0	34	114.9	68.9	94	166.4	99.7	54	217.9	130.5			
15	12.5	07.7	75	64.3	38.6	35	115.8	69.4	95	167.3	100.2	55	218.7	131.0			
16	13.7	08.2	76	65.2	39.1	36	116.6	69.9	96	168.1	100.7	56	219.6	131.1			
17	14.6	08.7	77	66.0	39.6	37	117.5	70.4	97	169.0	101.2	57	220.4	132.1			
18	15.4	09.3	78	66.9	40.1	38	118.4	70.9	98	169.8	101.8	58	221.0	132.6			
19	16.3	09.8	79	67.8	40.6	39	119.2	71.4	99	170.7	102.3	59	222.1	133.1			
20	17.2	10.3	80	68.6	41.1	40	120.1	72.0	200	171.5	102.8	60	223.0	133.6			
21	18.0	10.8	81	69.5	41.6	41	120.9	72.5	201	172.4	103.3	261	223.9	134.1			
22	18.9	11.3	82	70.3	42.2	42	121.8	73.0	02	173.3	103.8	62	224.7	134.6			
23	19.7	11.8	83	71.2	42.7	43	122.7	73.5	03	174.1	104.3	63	225.6	135.2			
24	20.6	12.3	84	72.0	43.2	44	123.5	74.0	04	175.0	104.8	64	226.4	135.7			
25	21.4	12.9	85	72.9	43.7	45	124.4	74.6	05	175.8	105.4	65	227.3	136.2			
26	22.3	13.4	86	73.8	44.2	46	125.2	75.0	06	176.7	105.9	66	228.1	136.7			
27	23.2	13.9	87	74.6	44.7	47	126.1	75.6	07	177.5	106.4	67	229.0	137.2			
28	24.0	14.4	88	75.5	45.2	48	126.9	76.1	08	178.4	106.9	68	229.9	137.7			
29	24.9	14.9	89	76.3	45.7	49	127.8	76.6	09	179.3	107.4	69	230.7	138.2			
30	25.7	15.4	90	77.2	46.3	50	128.7	77.1	10	180.1	107.9	70	231.6	138.8			
31	26.6	15.9	91	78.1	46.8	51	129.5	77.6	11	181.0	108.4	271	232.4	139.3			
32	27.4	16.4	92	78.9	47.3	52	130.4	78.1	12	181.8	109.0	72	233.3	139.8			
33	28.3	17.0	93	79.8	47.8	53	131.2	78.6	13	182.7	109.5	73	234.2	140.3			
34	29.2	17.5	94	80.6	48.3	54	132.1	79.1	14	183.5	110.0	74	235.0	140.8			
35	30.0	18.0	95	81.5	48.8	55	132.9	79.7	15	184.4	110.5	75	235.9	141.3			
36	30.9	18.5	96	82.3	49.3	56	133.8	80.2	16	185.3	111.0	76	236.7	141.8			
37	31.7	19.0	97	83.2	49.9	57	134.7	80.7	17	186.1	111.6	77	237.6	142.4			
38	32.6	19.5	98	84.1	50.4	58	135.5	81.2	18	187.0	112.0	78	238.4	142.9			
39	33.5	20.0	99	84.9	50.9	59	136.4	81.7	19	187.8	112.6	79	239.3	143.4			
40	34.3	20.6	100	85.8	51.4	60	137.2	82.2	20	188.7	113.1	80	240.2	143.9			
41	35.2	21.1	101	86.6	51.9	161	138.1	82.7	221	189.6	113.6	281	241.0	144.4			
42	36.0	21.6	02	87.5	52.4	62	138.9	83.3	22	190.4	114.1	82	241.9	144.9			
43	36.9	22.9	03	88.3	52.9	63	139.8	83.8	23	191.3	114.6	83	242.7	145.4			
44	37.7	22.0	04	89.2	53.4	64	140.7	84.3	24	192.1	115.1	84	243.6	146.0			
45	38.6	23.1	05	90.1	54.0	65	141.5	84.8	25	193.0	115.6	85	244.4	146.5			
46	39.5	23.6	06	90.9	54.5	66	142.4	85.3	26	193.8	116.1	86	245.3	147.0			
47	40.3	24.2	07	91.8	55.0	67	143.2	85.8	27	194.7	116.7	87	246.2	147.5			
48	41.2	24.7	08	92.6	55.5	68	144.1	86.3	28	195.6	117.2	88	247.0	148.0			
49	42.0	25.2	09	93.5	56.0	69	145.0	86.9	29	196.4	117.7	89	247.9	148.6			
50	42.9	25.7	10	94.3	56.5	70	145.8	87.4	30	197.3	118.2	90	248.7	149.0			
51	43.7	26.2	111	95.2	57.0	171	146.7	87.9	231	198.1	118.7	291	249.6	149.6			
52	44.6	26.7	12	96.1	57.6	72	147.5	88.4	32	199.0	119.2	92	250.4	150.1			
53	45.5	27.2	13	96.9	58.1	73	148.4	88.9	33	199.8	119.7	93	251.3	150.6			
54	46.3	27.8	14	97.8	58.6	74	149.2	89.4	34	200.7	120.3	94	252.2	151.1			
55	47.2	28.3	15	98.6	59.1	75	150.1	89.9	35	201.6	120.8	95	253.0	151.6			
56	48.0	28.8	16	99.5	59.6	76	151.0	90.4	36	202.4	121.3	96	253.9	152.1			
57	48.9	29.3	17	100.4	60.1	77	151.8	91.0	37	203.3	121.8	97	254.7	152.6			
58	49.7	29.8	18	101.2	60.6	78	152.7	91.5	38	204.1	122.3	98	255.6	153.1			
59	50.6	30.3	19	102.1	61.2	79	153.5	92.0	39	205.0	122.8	99	256.5	153.8			
60	51.5	30.8	20	102.9	61.7	80	154.4	92.5	40	205.8	123.3	300	257.3	154.2			
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 3 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.5	241	200.4	133.9
2	01.7	01.1	62	51.5	34.4	22	101.4	67.8	82	151.3	101.1	42	201.2	134.4
3	02.5	01.7	63	52.4	35.0	23	102.3	68.3	83	152.1	101.7	43	202.0	135.0
4	03.3	02.2	64	53.2	35.6	24	103.1	68.9	84	153.0	102.2	44	202.8	135.5
5	04.2	02.8	65	54.0	36.1	25	103.9	69.4	85	153.8	102.8	45	203.7	136.1
6	05.0	03.3	66	54.9	36.7	26	104.8	70.0	86	154.6	103.3	46	204.5	136.7
7	05.8	03.9	67	55.7	37.2	27	105.6	70.5	87	155.5	103.9	47	205.3	137.2
8	06.7	04.4	68	56.5	37.8	28	106.4	71.1	88	156.3	104.4	48	206.2	137.8
9	07.5	05.0	69	57.4	38.3	29	107.2	71.7	89	157.1	105.0	49	207.0	138.3
10	08.3	05.6	70	58.2	38.9	30	108.1	72.2	90	158.0	105.5	50	207.8	138.9
11	09.1	06.1	71	59.0	39.4	31	108.9	72.8	191	158.8	106.1	51	208.7	139.4
12	10.0	06.7	72	59.9	40.0	32	109.7	73.3	92	159.6	106.7	52	209.5	140.0
13	10.8	07.2	73	60.7	40.6	33	110.6	73.9	93	160.4	107.2	53	210.3	140.5
14	11.6	07.8	74	61.5	41.1	34	111.4	74.4	94	161.3	107.8	54	211.2	141.1
15	12.5	08.3	75	62.4	41.7	35	112.2	75.0	95	162.1	108.3	55	212.0	141.7
16	13.3	08.9	76	63.2	42.2	36	113.1	75.5	96	162.9	108.9	56	212.8	142.2
17	14.1	09.4	77	64.0	42.8	37	113.9	76.1	97	163.8	109.4	57	213.7	142.8
18	15.0	10.0	78	64.8	43.3	38	114.7	76.7	98	164.6	110.0	58	214.5	143.3
19	15.8	10.6	79	65.7	43.9	39	115.6	77.2	99	165.4	110.5	59	215.3	143.9
20	16.6	11.1	80	66.5	44.4	40	116.4	77.8	200	166.3	111.1	60	216.1	144.4
21	17.5	11.7	81	67.3	45.0	41	117.2	78.3	201	167.1	111.7	61	217.0	145.0
22	18.3	12.2	82	68.2	45.6	42	118.1	78.9	02	167.9	112.2	62	217.8	145.5
23	19.1	12.8	83	69.0	46.1	43	118.9	79.4	03	168.8	112.8	63	218.6	146.1
24	20.0	13.3	84	69.8	46.7	44	119.7	80.0	04	169.6	113.3	64	219.5	146.7
25	20.8	13.9	85	70.7	47.2	45	120.5	80.5	05	170.4	113.9	65	220.3	147.2
26	21.6	14.4	86	71.5	47.8	46	121.4	81.1	06	171.3	114.4	66	221.1	147.8
27	22.4	15.0	87	72.3	48.3	47	122.2	81.7	07	172.1	115.0	67	222.0	148.3
28	23.3	15.6	88	73.2	48.9	48	123.0	82.2	08	172.9	115.5	68	222.8	148.9
29	24.1	16.1	89	74.0	49.4	49	123.9	82.8	09	173.8	116.1	69	223.6	149.4
30	24.9	16.7	90	74.8	50.0	50	124.7	83.3	10	174.6	116.7	70	224.5	150.0
31	25.8	17.2	91	75.7	50.6	51	125.5	83.9	211	175.4	117.2	71	225.3	150.5
32	26.6	17.8	92	76.5	51.1	52	126.4	84.4	12	176.2	117.8	72	226.1	151.1
33	27.4	18.3	93	77.3	51.7	53	127.2	85.0	13	177.1	118.3	73	227.0	151.7
34	28.3	18.9	94	78.1	52.2	54	128.0	85.5	14	177.9	118.9	74	227.8	152.2
35	29.1	19.4	95	79.0	52.8	55	128.9	86.1	15	178.7	119.4	75	228.6	152.8
36	29.9	20.0	96	79.8	53.3	56	129.7	86.7	16	179.6	120.0	76	229.4	153.3
37	30.8	20.6	97	80.6	53.9	57	130.5	87.2	17	180.4	120.5	77	230.0	153.9
38	31.6	21.1	98	81.5	54.4	58	131.4	87.8	18	181.2	121.1	78	231.1	154.4
39	32.4	21.7	99	82.3	55.0	59	132.2	88.3	19	182.1	121.7	79	231.9	155.0
40	33.3	22.2	100	83.1	55.6	60	133.0	88.9	20	182.9	122.2	80	232.8	155.5
41	34.1	22.8	101	84.0	56.1	61	133.8	89.4	221	183.7	122.8	281	233.6	156.1
42	34.9	23.3	02	84.8	56.7	62	134.7	90.0	22	184.6	123.3	82	234.4	156.7
43	35.8	23.9	03	85.6	57.2	63	135.5	90.5	23	185.4	123.9	83	235.3	157.2
44	36.6	24.4	04	86.5	57.8	64	136.3	91.1	24	186.2	124.4	84	236.1	157.8
45	37.4	25.0	05	87.3	58.3	65	137.2	91.7	25	187.1	125.0	85	236.9	158.3
46	38.2	25.6	06	88.1	58.9	66	138.0	92.2	26	187.9	125.5	86	237.8	158.9
47	39.1	26.1	07	89.0	59.4	67	138.8	92.8	27	188.7	126.1	87	238.6	159.4
48	39.9	26.7	08	89.8	60.0	68	139.7	93.3	28	189.5	126.7	88	239.4	160.0
49	40.7	27.2	09	90.6	60.5	69	140.5	93.9	29	190.4	127.2	89	240.3	160.5
50	41.6	27.8	10	91.4	61.1	70	141.3	94.4	30	191.2	127.8	90	241.1	161.1
51	42.4	28.3	111	92.3	61.7	71	142.2	95.0	231	192.0	128.3	291	242.9	161.7
52	43.2	28.9	12	93.1	62.2	72	143.0	95.5	32	192.9	128.9	92	243.8	162.2
53	44.1	29.4	13	93.9	62.8	73	143.8	96.1	33	193.7	129.4	93	244.6	162.8
54	44.9	30.0	14	94.8	63.3	74	144.7	96.7	34	194.5	130.0	94	244.4	163.3
55	45.7	30.6	15	95.6	63.9	75	145.5	97.2	35	195.4	130.5	95	245.2	163.9
56	46.6	31.1	16	96.4	64.4	76	146.3	97.8	36	196.2	131.1	96	246.1	164.4
57	47.4	31.7	17	97.3	65.0	77	147.1	98.3	37	197.0	131.7	97	246.9	165.0
58	48.2	32.2	18	98.1	65.5	78	148.0	98.9	38	197.9	132.2	98	247.7	165.5
59	49.1	32.8	19	98.9	66.1	79	148.8	99.4	39	198.7	132.8	99	248.5	166.1
60	49.9	33.3	20	99.8	66.7	80	149.6	100.0	40	199.5	133.3	300	249.4	166.7
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 5 Points.

Difference of Latitude and Departure for $3\frac{1}{4}$ Points.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.5	143.0
2	01.6	01.2	62	49.8	36.9	22	98.0	72.7	82	146.2	108.4	42	194.3	144.2
3	02.4	01.8	63	50.6	37.5	23	98.8	73.3	83	147.0	109.0	43	195.1	144.8
4	03.2	02.4	64	51.4	38.1	24	99.6	73.9	84	147.8	109.6	44	195.9	145.4
5	04.0	03.0	65	52.2	38.7	25	100.4	74.5	85	148.6	110.2	45	196.7	146.0
6	04.8	03.6	66	53.0	39.3	26	101.2	75.1	86	149.4	110.8	46	197.5	146.6
7	05.6	04.2	67	53.8	39.9	27	102.0	75.7	87	150.2	111.4	47	198.4	147.1
8	06.4	04.8	68	54.6	40.5	28	102.8	76.3	88	151.0	112.0	48	199.2	147.7
9	07.2	05.4	69	55.4	41.1	29	103.6	76.9	89	151.8	112.6	49	200.0	148.3
10	08.0	06.0	70	56.2	41.7	30	104.4	77.4	90	152.6	113.2	50	200.8	148.9
11	08.8	06.6	71	57.0	42.3	31	105.2	78.0	91	153.4	113.8	51	201.6	149.5
12	09.6	07.1	72	57.8	42.9	32	106.0	78.6	92	154.2	114.4	52	202.4	150.1
13	10.4	07.7	73	58.6	43.5	33	106.8	79.2	93	155.0	115.0	53	203.2	150.7
14	11.2	08.3	74	59.4	44.1	34	107.6	79.8	94	155.8	115.6	54	204.0	151.3
15	12.0	08.9	75	60.2	44.7	35	108.4	80.4	95	156.6	116.2	55	204.8	151.9
16	12.8	09.5	76	61.0	45.3	36	109.2	81.0	96	157.4	116.8	56	205.6	152.5
17	13.7	10.1	77	61.8	45.9	37	110.0	81.6	97	158.2	117.4	57	206.4	153.1
18	14.5	10.7	78	62.6	46.5	38	110.8	82.2	98	159.0	118.0	58	207.2	153.7
19	15.3	11.3	79	63.4	47.1	39	111.6	82.8	99	159.8	118.6	59	208.0	154.3
20	16.1	11.9	80	64.2	47.7	40	112.4	83.4	200	160.6	119.1	60	208.8	154.9
21	16.9	12.5	81	65.0	48.3	41	113.2	84.0	201	161.4	119.7	61	209.6	155.5
22	17.7	13.1	82	65.8	48.9	42	114.0	84.6	02	162.2	120.3	62	210.4	156.1
23	18.5	13.7	83	66.7	49.4	43	114.8	85.2	03	163.0	120.9	63	211.2	156.7
24	19.3	14.3	84	67.5	50.0	44	115.6	85.8	04	163.8	121.5	64	212.0	157.3
25	20.1	14.9	85	68.3	50.6	45	116.4	86.4	05	164.6	122.1	65	212.8	157.9
26	20.9	15.5	86	69.1	51.2	46	117.2	87.0	06	165.4	122.7	66	213.6	158.5
27	21.7	16.1	87	69.9	51.8	47	118.0	87.6	07	166.2	123.3	67	214.4	159.1
28	22.5	16.7	88	70.7	52.4	48	118.8	88.2	08	167.0	123.9	68	215.2	159.7
29	23.3	17.3	89	71.5	53.0	49	119.7	88.8	09	167.8	124.5	69	216.0	160.3
30	24.1	17.9	90	72.3	53.6	50	120.5	89.4	10	168.6	125.1	70	216.8	160.9
31	24.9	18.5	91	73.1	54.2	51	121.3	90.0	211	169.4	125.7	71	217.6	161.4
32	25.7	19.1	92	73.9	54.8	52	122.1	90.6	12	170.2	126.3	72	218.4	162.0
33	26.5	19.7	93	74.7	55.4	53	122.9	91.1	13	171.0	126.9	73	219.2	162.6
34	27.3	20.3	94	75.5	56.0	54	123.7	91.7	14	171.8	127.5	74	220.0	163.2
35	28.1	20.9	95	76.3	56.6	55	124.5	92.3	15	172.7	128.1	75	220.8	163.8
36	28.9	21.4	96	77.1	57.2	56	125.3	92.9	16	173.5	128.7	76	221.6	164.4
37	29.7	22.0	97	77.9	57.8	57	126.1	93.5	17	174.3	129.3	77	222.4	165.0
38	30.5	22.6	98	78.7	58.4	58	126.9	94.1	18	175.1	129.9	78	223.2	165.6
39	31.3	23.2	99	79.5	59.0	59	127.7	94.7	19	175.9	130.5	79	224.0	166.2
40	32.1	23.8	100	80.3	59.6	60	128.5	95.3	20	176.7	131.1	80	224.8	166.8
41	32.9	24.4	101	81.1	60.2	61	129.3	95.9	221	177.5	131.7	281	225.7	167.4
42	33.7	25.0	02	81.9	60.8	62	130.1	96.5	22	178.3	132.3	82	226.5	168.0
43	34.5	25.6	03	82.7	61.4	63	130.9	97.1	23	179.1	132.9	83	227.3	168.6
44	35.3	26.2	04	83.5	62.0	64	131.7	97.7	24	179.9	133.4	84	228.1	169.2
45	36.1	26.8	05	84.3	62.6	65	132.5	98.3	25	180.7	134.0	85	228.9	169.8
46	36.9	27.4	06	85.1	63.1	66	133.3	98.9	26	181.5	134.6	86	229.7	170.4
47	37.7	28.0	07	85.9	63.7	67	134.1	99.5	27	182.3	135.2	87	230.5	171.0
48	38.5	28.6	08	86.7	64.3	68	134.9	100.1	28	183.1	135.8	88	231.3	171.6
49	39.3	29.2	09	87.5	64.9	69	135.7	100.7	29	183.9	136.4	89	232.1	172.2
50	40.2	29.8	10	88.3	65.5	70	136.5	101.3	30	184.7	137.0	90	232.9	172.8
51	41.0	30.4	111	89.1	66.1	171	137.3	101.9	231	185.5	137.6	291	233.7	173.4
52	41.8	31.0	12	89.9	66.7	72	138.1	102.5	32	186.3	138.2	92	234.5	174.0
53	42.6	31.6	13	90.7	67.3	73	138.9	103.1	33	187.1	138.8	93	235.3	174.6
54	43.4	32.2	14	91.5	67.9	74	139.7	103.7	34	187.9	139.4	94	236.1	175.1
55	44.2	32.8	15	92.4	68.5	75	140.5	104.3	35	188.7	140.0	95	236.9	175.7
56	45.0	33.4	16	93.2	69.1	76	141.3	104.9	36	189.5	140.6	96	237.7	176.3
57	45.8	34.0	17	94.0	69.7	77	142.1	105.4	37	190.3	141.2	97	238.5	176.9
58	46.6	34.6	18	94.8	70.3	78	142.9	106.0	38	191.1	141.8	98	239.3	177.5
59	47.1	35.1	19	95.6	70.9	79	143.7	106.6	39	191.9	142.4	99	240.1	178.1
60	48.2	35.7	20	96.4	71.5	80	144.5	107.2	40	192.7	143.0	300	240.9	178.7
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for $4\frac{3}{4}$ Points.

Difference of Latitude and Departure for 3 1/2 Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.7	181	139.9	114.8	241	186.2	152.8
2	01.5	01.3	62	47.9	39.3	22	94.3	77.4	82	140.6	115.4	42	187.0	153.5
3	02.3	01.9	63	48.7	40.0	23	95.1	78.0	83	141.4	116.0	43	187.8	154.1
4	03.1	02.5	64	49.5	40.6	24	95.8	78.6	84	142.2	116.7	44	188.6	154.7
5	03.9	03.2	65	50.2	41.2	25	96.6	79.3	85	143.0	117.3	45	189.3	155.4
6	04.6	03.8	66	51.0	41.9	26	97.4	79.9	86	143.7	118.0	46	190.1	156.0
7	05.4	04.4	67	51.8	42.5	27	98.1	80.5	87	144.5	118.6	47	190.9	156.6
8	06.2	05.1	68	52.6	43.1	28	98.9	81.2	88	145.3	119.3	48	191.6	157.3
9	07.0	05.7	69	53.3	43.8	29	99.7	81.8	89	146.1	119.9	49	192.4	157.9
10	07.7	06.3	70	54.1	44.4	30	100.5	82.4	90	146.8	120.5	50	193.2	158.5
11	08.5	07.0	71	54.9	45.0	31	101.2	83.1	91	147.6	121.1	51	194.0	159.2
12	09.3	07.6	72	55.6	45.7	32	102.0	83.7	92	148.4	121.8	52	194.7	159.8
13	10.1	08.2	73	56.4	46.3	33	102.8	84.3	93	149.1	122.4	53	195.5	160.4
14	10.8	08.9	74	57.2	46.9	34	103.6	85.0	94	149.9	123.0	54	196.3	161.1
15	11.6	09.5	75	58.0	47.6	35	104.3	85.6	95	150.7	123.7	55	197.1	161.7
16	12.4	10.1	76	58.7	48.2	36	105.1	86.2	96	151.8	124.3	56	197.8	162.3
17	13.1	10.8	77	59.5	48.8	37	105.9	86.9	97	152.2	124.9	57	198.6	163.0
18	13.9	11.4	78	60.3	49.5	38	106.6	87.5	98	153.0	125.6	58	199.4	163.6
19	14.7	12.0	79	61.1	50.1	39	107.4	88.1	99	153.8	126.2	59	200.1	164.1
20	15.5	12.7	80	61.8	50.7	40	108.2	88.8	200	154.6	126.8	60	200.9	164.9
21	16.2	13.3	81	62.6	51.4	41	109.0	89.4	201	155.3	127.5	61	201.7	165.5
22	17.0	14.0	82	63.4	52.0	42	109.7	90.0	02	156.1	128.1	62	202.5	166.1
23	17.8	14.6	83	64.1	52.6	43	110.5	90.7	03	156.9	128.7	63	203.2	166.8
24	18.5	15.2	84	64.9	53.3	44	111.3	91.3	04	157.6	129.4	64	204.0	167.4
25	19.3	15.9	85	65.7	53.9	45	112.1	92.0	05	158.4	130.0	65	204.8	168.0
26	20.1	16.5	86	66.5	54.5	46	112.8	92.6	06	159.2	130.6	66	205.6	168.7
27	20.9	17.1	87	67.2	55.2	47	113.6	93.2	07	160.0	131.3	67	206.3	169.3
28	21.6	17.8	88	68.0	55.8	48	114.4	93.9	08	160.7	131.9	68	207.1	170.0
29	22.4	18.4	89	68.8	56.4	49	115.1	94.5	09	161.5	132.5	69	207.9	170.7
30	23.2	19.0	90	69.6	57.1	50	115.9	95.1	10	162.3	133.2	70	208.6	171.2
31	24.0	19.7	91	70.3	57.7	51	116.7	95.8	211	163.1	133.8	71	209.4	171.9
32	24.7	20.3	92	71.1	58.3	52	117.5	96.4	12	163.8	134.4	72	210.2	172.5
33	25.5	20.9	93	71.9	59.0	53	118.2	97.0	13	164.6	135.1	73	211.0	173.1
34	26.3	21.6	94	72.6	59.6	54	119.0	97.7	14	165.4	135.7	74	211.7	173.8
35	27.1	22.2	95	73.4	60.2	55	119.8	98.3	15	166.1	136.3	75	212.5	174.4
36	27.8	22.8	96	74.2	60.9	56	120.6	98.9	16	166.9	137.0	76	213.3	175.0
37	28.6	23.5	97	75.0	61.5	57	121.3	99.6	17	167.7	137.6	77	214.1	175.7
38	29.4	24.1	98	75.7	62.1	58	122.1	100.2	18	168.5	138.2	78	214.8	176.3
39	30.1	24.7	99	76.5	62.8	59	122.9	100.8	19	169.2	138.9	79	215.6	176.9
40	30.9	25.4	100	77.3	63.4	60	123.6	101.5	20	170.0	139.5	80	216.4	177.6
41	31.7	26.0	101	78.1	64.0	61	124.4	102.1	211	170.8	140.1	281	217.1	178.2
42	32.5	26.6	02	78.8	64.7	62	125.2	102.7	22	171.6	140.8	82	217.9	178.8
43	33.2	27.3	03	79.6	65.3	63	126.0	103.4	23	172.3	141.4	83	218.7	179.5
44	34.0	27.9	04	80.4	66.0	64	126.7	104.0	24	173.1	142.0	84	219.5	180.1
45	34.8	28.5	05	81.1	66.6	65	127.5	104.6	25	173.9	142.7	85	220.2	180.7
46	35.6	29.2	06	81.9	67.2	66	128.3	105.3	26	174.6	143.3	86	221.0	181.4
47	36.3	29.8	07	82.7	67.9	67	129.1	105.9	27	175.4	144.0	87	221.8	182.0
48	37.1	30.4	08	83.5	68.5	68	129.8	106.5	28	176.2	144.6	88	222.6	182.6
49	37.9	31.1	09	84.2	69.1	69	130.6	107.2	29	177.0	145.2	89	223.3	183.3
50	38.6	31.7	10	85.0	69.8	70	131.4	107.8	30	177.7	145.9	90	224.1	183.0
51	39.4	32.3	111	85.8	70.4	171	132.1	108.4	231	178.5	146.5	291	224.9	184.5
52	40.2	33.0	12	86.6	71.0	72	132.9	109.1	32	179.3	147.1	92	225.6	185.2
53	41.0	33.6	13	87.3	71.7	73	133.7	109.7	33	180.1	147.8	93	226.4	185.8
54	42.7	34.2	14	88.1	72.3	74	134.5	110.3	34	180.8	148.4	94	227.2	186.4
55	42.5	34.9	15	88.9	72.9	75	135.2	111.0	35	181.6	149.0	95	228.0	187.1
56	43.3	35.5	16	89.6	73.6	76	136.0	111.6	36	182.4	149.7	96	228.7	187.7
57	44.1	36.1	17	90.4	74.2	77	136.8	112.2	37	183.1	150.3	97	229.5	188.3
58	44.8	36.8	18	91.2	74.8	78	137.6	112.9	38	183.9	150.9	98	230.3	189.0
59	45.6	37.4	19	92.0	75.5	79	138.3	113.5	39	184.7	151.6	99	231.1	189.6
60	46.4	38.0	20	92.7	76.3	80	139.1	114.1	40	185.5	152.2	300	231.8	190.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 1/2 Points.

Difference of Latitude and Departure for 3 $\frac{1}{4}$ Points.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.6	81.2	181	134.1	121.5	241	178.5	161.8
2	01.5	01.3	62	45.9	41.6	22	90.4	81.9	82	134.8	122.2	42	179.3	162.5
3	02.2	02.0	63	46.7	42.3	23	91.1	82.6	83	135.6	122.9	43	180.0	163.2
4	03.0	02.7	64	47.4	43.0	24	91.9	83.3	84	136.3	123.5	44	180.7	163.3
5	03.7	03.4	65	48.2	43.6	25	92.6	83.9	85	137.0	124.2	45	181.5	164.5
6	04.4	04.0	66	48.9	44.3	26	93.3	84.6	86	137.8	124.9	46	182.2	165.2
7	05.2	04.7	67	49.6	45.0	27	94.1	85.3	87	138.5	125.6	47	183.0	165.8
8	05.9	05.4	68	50.4	45.7	28	94.8	85.9	88	139.3	126.2	48	183.7	166.5
9	06.7	06.0	69	51.1	46.3	29	95.6	86.6	89	140.0	126.9	49	184.4	167.2
10	07.4	06.7	70	51.9	47.0	30	96.3	87.3	90	140.7	127.6	50	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.0	88.0	191	141.5	128.2	251	185.9	168.5
12	08.9	08.1	72	53.3	48.3	32	97.8	88.6	92	142.2	128.9	52	186.7	169.2
13	09.6	08.7	73	54.1	49.0	33	98.5	89.3	93	143.0	129.6	53	187.4	169.9
14	10.4	09.4	74	54.8	49.7	34	99.3	90.0	94	143.7	130.3	54	188.2	170.5
15	11.1	10.1	75	55.6	50.4	35	100.0	90.6	95	144.4	130.9	55	188.9	171.2
16	11.9	10.7	76	56.3	51.0	36	100.7	91.3	96	145.2	131.6	56	189.6	171.9
17	12.6	11.4	77	57.0	51.7	37	101.5	92.0	97	145.9	132.3	57	190.4	172.6
18	13.3	12.1	78	57.8	52.4	38	102.2	92.7	98	146.7	132.9	58	191.1	173.2
19	14.1	12.8	79	58.5	53.0	39	103.0	93.3	99	147.4	133.6	59	191.9	173.9
20	14.8	13.4	80	59.3	53.7	40	103.7	94.0	200	148.2	134.3	60	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.4	94.7	201	148.9	135.0	261	193.3	175.2
22	16.3	14.8	82	60.7	55.1	42	105.2	95.3	02	149.6	135.6	62	194.1	175.9
23	17.0	15.4	83	61.5	55.9	43	105.9	96.0	03	150.4	136.3	63	194.8	176.6
24	17.8	16.1	84	62.2	56.4	44	106.7	96.7	04	151.1	137.0	64	195.6	177.3
25	18.5	16.8	85	63.0	57.1	45	107.4	97.4	05	151.9	137.6	65	196.3	177.9
26	19.3	17.5	86	63.7	57.7	46	108.2	98.0	06	152.6	138.3	66	197.0	178.6
27	20.0	18.1	87	64.4	58.4	47	108.9	98.7	07	153.3	139.0	67	197.8	179.3
28	20.7	18.8	88	65.2	59.1	48	109.6	99.4	08	154.1	139.7	68	198.5	179.9
29	21.5	19.5	89	65.9	59.8	49	110.4	100.0	09	154.8	140.3	69	199.3	180.6
30	22.2	20.1	90	66.7	60.4	50	111.1	100.7	10	155.6	141.0	70	200.0	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.7	182.0
32	23.7	21.5	92	68.2	61.8	52	112.6	102.1	12	157.0	142.3	72	201.5	182.6
33	24.4	22.2	93	68.9	62.4	53	113.3	102.7	13	157.8	143.0	73	202.2	183.3
34	25.2	22.8	94	69.6	63.1	54	114.1	103.4	14	158.5	143.7	74	203.0	184.0
35	25.9	23.5	95	70.4	63.8	55	114.8	104.1	15	159.3	144.4	75	203.7	184.6
36	26.7	24.2	96	71.1	64.5	56	115.6	104.7	16	160.0	145.0	76	204.4	185.3
37	27.4	24.8	97	71.9	65.1	57	116.3	105.4	17	160.7	145.7	77	205.2	186.0
38	28.2	25.5	98	72.6	65.8	58	117.0	106.1	18	161.5	146.4	78	205.9	186.7
39	28.9	26.2	99	73.3	66.5	59	117.8	106.8	19	162.2	147.0	79	206.7	187.3
40	29.6	26.9	100	74.1	67.1	60	118.5	107.4	20	163.0	147.7	80	207.4	188.0
41	30.4	27.7	101	74.8	67.8	161	119.3	108.1	221	163.7	148.4	281	208.2	188.7
42	31.1	28.2	02	75.6	68.5	62	120.0	108.8	22	164.4	149.1	82	208.9	189.3
43	31.9	28.9	03	76.3	69.2	63	120.7	109.4	23	165.2	149.7	83	209.6	190.0
44	32.6	29.5	04	77.0	69.8	64	121.5	110.1	24	165.9	150.4	84	210.4	190.7
45	33.3	30.2	05	77.8	70.5	65	122.2	110.8	25	166.7	151.1	85	211.1	191.4
46	34.1	30.9	06	78.5	71.2	66	123.0	111.5	26	167.4	151.7	86	211.9	192.0
47	34.8	31.6	07	79.3	71.8	67	123.7	112.1	27	168.2	152.4	87	212.6	192.7
48	35.6	32.2	08	80.0	72.5	68	124.4	112.8	28	168.9	153.1	88	213.3	193.4
49	36.3	32.9	09	80.7	73.2	69	125.2	113.5	29	169.6	153.8	89	214.1	194.0
50	37.0	33.6	10	81.5	73.9	70	125.9	114.1	30	170.4	154.9	90	214.8	194.7
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.1	155.1	291	215.6	195.4
52	38.5	34.9	12	83.0	75.2	72	127.4	115.5	32	171.9	155.8	92	216.3	196.1
53	39.3	35.6	13	83.7	75.9	73	128.2	116.2	33	172.6	156.4	93	217.0	196.7
54	40.0	36.3	14	84.4	76.5	74	128.9	116.8	34	173.3	157.1	94	217.8	197.4
55	40.7	36.9	15	85.2	77.2	75	129.6	117.5	35	174.1	157.8	95	218.5	198.1
56	41.5	37.6	16	85.9	77.9	76	130.4	118.2	36	174.8	158.5	96	219.3	198.7
57	42.2	38.3	17	86.7	78.6	77	131.1	118.8	37	175.6	159.1	97	220.0	199.4
58	43.0	38.9	18	87.4	79.2	78	131.9	119.5	38	176.3	159.8	98	220.7	200.1
59	43.7	39.6	19	88.2	79.9	79	132.6	120.2	39	177.0	160.5	99	221.5	200.8
60	44.5	40.3	20	88.9	80.6	80	133.3	120.9	40	177.8	161.1	300	222.2	201.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 4 $\frac{1}{4}$ Point.

Difference of Latitude and Departure for 4 Points.

D. ft	Lat.	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.1	132.1	47	174.6	174.6
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.3	134.3	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	93.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.7	94.7	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.5	184.5
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	144.9	144.9	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.6	104.6	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.4	194.4
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.8	154.8	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.5	114.5	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	74.9	74.9	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.3	204.3
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.7	164.7	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.4	124.4	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.8	84.8	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.

for 4 Points.

Difference of Latitude and Departure for 1 Degree.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.1	241	241.0	04.1
2	02.0	00.0	62	62.0	01.1	122	122.0	02.1	182	182.0	03.1	242	242.0	04.2
3	03.0	00.1	63	63.0	01.1	123	123.0	02.1	183	183.0	03.2	243	243.0	04.2
4	04.0	00.1	64	64.0	01.1	124	124.0	02.2	184	184.0	03.2	244	244.0	04.2
5	05.0	00.1	65	65.0	01.1	125	125.0	02.2	185	185.0	03.2	245	245.0	04.2
6	06.0	00.1	66	66.0	01.2	126	126.0	02.2	186	186.0	03.2	246	246.0	04.2
7	07.0	00.1	67	67.0	01.2	127	127.0	02.2	187	187.0	03.2	247	247.0	04.2
8	08.0	00.1	68	68.0	01.2	128	128.0	02.2	188	188.0	03.2	248	248.0	04.3
9	09.0	00.2	69	69.0	01.2	129	129.0	02.2	189	189.0	03.3	249	249.0	04.3
10	10.0	00.2	70	70.0	01.2	130	130.0	02.3	190	190.0	03.3	250	250.0	04.3
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.3
12	12.0	00.2	72	72.0	01.3	132	132.0	02.3	192	192.0	03.3	252	252.0	04.3
13	13.0	00.2	73	73.0	01.3	133	133.0	02.3	193	193.0	03.3	253	253.0	04.3
14	14.0	00.2	74	74.0	01.3	134	134.0	02.3	194	194.0	03.3	254	254.0	04.4
15	15.0	00.3	75	75.0	01.3	135	135.0	02.3	195	195.0	03.4	255	255.0	04.4
16	16.0	00.3	76	76.0	01.3	136	136.0	02.4	196	196.0	03.4	256	256.0	04.4
17	17.0	00.3	77	77.0	01.3	137	137.0	02.4	197	197.0	03.4	257	257.0	04.4
18	18.0	00.3	78	78.0	01.4	138	138.0	02.4	198	198.0	03.4	258	258.0	04.4
19	19.0	00.3	79	79.0	01.4	139	139.0	02.4	199	199.0	03.4	259	259.0	04.4
20	20.0	00.4	80	80.0	01.4	140	140.0	02.4	200	200.0	03.4	260	260.0	04.4
21	21.0	00.4	81	81.0	01.4	141	141.0	02.4	201	201.0	03.5	261	261.0	04.5
22	22.0	00.4	82	82.0	01.4	142	142.0	02.5	202	202.0	03.5	262	262.0	04.5
23	23.0	00.4	83	83.0	01.5	143	143.0	02.5	203	203.0	03.5	263	263.0	04.5
24	24.0	00.4	84	84.0	01.5	144	144.0	02.5	204	204.0	03.5	264	264.0	04.5
25	25.0	00.4	85	85.0	01.5	145	145.0	02.5	205	205.0	03.5	265	265.0	04.6
26	26.0	00.5	86	86.0	01.5	146	146.0	02.5	206	206.0	03.5	266	266.0	04.6
27	27.0	00.5	87	87.0	01.5	147	147.0	02.5	207	207.0	03.6	267	267.0	04.6
28	28.0	00.5	88	88.0	01.5	148	148.0	02.6	208	208.0	03.6	268	268.0	04.6
29	29.0	00.5	89	89.0	01.6	149	149.0	02.6	209	209.0	03.6	269	269.0	04.6
30	30.0	00.5	90	90.0	01.6	150	150.0	02.6	210	210.0	03.6	270	270.0	04.6
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.6	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	152	152.0	02.6	212	212.0	03.6	272	272.0	04.7
33	33.0	00.6	93	93.0	01.6	153	153.0	02.7	213	213.0	03.7	273	273.0	04.7
34	34.0	00.6	94	94.0	01.6	154	154.0	02.7	214	214.0	03.7	274	274.0	04.7
35	35.0	00.6	95	95.0	01.7	155	155.0	02.7	215	215.0	03.7	275	275.0	04.7
36	36.0	00.6	96	96.0	01.7	156	156.0	02.7	216	216.0	03.7	276	276.0	04.7
37	37.0	00.6	97	97.0	01.7	157	157.0	02.7	217	217.0	03.7	277	277.0	04.8
38	38.0	00.7	98	98.0	01.7	158	158.0	02.7	218	218.0	03.8	278	278.0	04.8
39	39.0	00.7	99	99.0	01.7	159	159.0	02.7	219	219.0	03.8	279	279.0	04.8
40	40.0	00.7	100	100.0	01.7	160	160.0	02.8	220	220.0	03.8	280	280.0	04.8
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.8	281	281.0	04.8
42	42.0	00.7	102	102.0	01.8	162	162.0	02.8	222	222.0	03.8	282	282.0	04.8
43	43.0	00.8	103	103.0	01.8	163	163.0	02.8	223	223.0	03.8	283	283.0	04.9
44	44.0	00.8	104	104.0	01.8	164	164.0	02.8	224	224.0	03.9	284	284.0	04.9
45	45.0	00.8	105	105.0	01.8	165	165.0	02.9	225	225.0	03.9	285	285.0	04.9
46	46.0	00.8	106	106.0	01.8	166	166.0	02.9	226	226.0	03.9	286	286.0	04.9
47	47.0	00.8	107	107.0	01.9	167	167.0	02.9	227	227.0	03.9	287	287.0	04.9
48	48.0	00.8	108	108.0	01.9	168	168.0	02.9	228	228.0	03.9	288	288.0	04.9
49	49.0	00.9	109	109.0	01.9	169	169.0	02.9	229	229.0	03.9	289	289.0	05.0
50	50.0	00.9	110	110.0	01.9	170	170.0	02.9	230	230.0	04.0	290	290.0	05.0
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.0
52	52.0	00.9	112	112.0	01.9	172	172.0	03.0	232	232.0	04.0	292	292.0	05.0
53	53.0	00.9	113	113.0	02.0	173	173.0	03.0	233	233.0	04.0	293	293.0	05.0
54	54.0	00.9	114	114.0	02.0	174	174.0	03.0	234	234.0	04.0	294	294.0	05.0
55	55.0	01.0	115	115.0	02.0	175	175.0	03.0	235	235.0	04.0	295	295.0	05.1
56	56.0	01.0	116	116.0	02.0	176	176.0	03.0	236	236.0	04.1	296	296.0	05.1
57	57.0	01.0	117	117.0	02.0	177	177.0	03.1	237	237.0	04.1	297	297.0	05.1
58	58.0	01.0	118	118.0	02.1	178	178.0	03.1	238	238.0	04.1	298	298.0	05.1
59	59.0	01.0	119	119.0	02.1	179	179.0	03.1	239	239.0	04.1	299	299.0	05.1
60	60.0	01.1	120	120.0	02.1	180	180.0	03.1	240	240.0	04.1	300	300.0	05.1
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 2 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	22	121.9	04.3	82	181.9	06.4	42	241.9	08.5
3	03.0	00.1	63	63.0	02.2	23	122.9	04.3	83	182.9	06.4	43	242.9	08.5
4	04.0	00.1	64	64.0	02.2	24	123.9	04.3	84	183.9	06.4	44	243.9	08.5
5	05.0	00.2	65	65.0	02.3	25	124.9	04.4	85	184.9	06.5	45	244.9	08.6
6	06.0	00.2	66	66.0	02.3	26	125.9	04.4	86	185.9	06.5	46	245.9	08.6
7	07.0	00.2	67	67.0	02.3	27	126.9	04.4	87	186.9	06.5	47	246.9	08.6
8	08.0	00.3	68	68.0	02.4	28	127.9	04.5	88	187.9	06.6	48	247.9	08.7
9	09.0	00.3	69	69.0	02.4	29	128.9	04.5	89	188.9	06.6	49	248.9	08.7
10	10.0	00.3	70	70.0	02.4	30	129.9	04.6	90	189.9	06.7	50	249.9	08.8
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	32	131.9	04.6	92	191.9	06.7	52	251.8	08.8
13	13.0	00.5	73	73.0	02.5	33	132.9	04.7	93	192.9	06.8	53	252.8	08.9
14	14.0	00.5	74	74.0	02.6	34	133.9	04.7	94	193.9	06.8	54	253.8	08.9
15	15.0	00.5	75	75.0	02.6	35	134.9	04.7	95	194.9	06.8	55	254.8	08.9
16	16.0	00.6	76	76.0	02.7	36	135.9	04.8	96	195.9	06.9	56	255.8	09.0
17	17.0	00.6	77	77.0	02.7	37	136.9	04.8	97	196.9	06.9	57	256.8	09.0
18	18.0	00.6	78	78.0	02.7	38	137.9	04.8	98	197.9	06.9	58	257.8	09.0
19	19.0	00.7	79	79.0	02.8	39	138.9	04.9	99	198.9	07.0	59	258.8	09.1
20	20.0	00.7	80	80.0	02.8	40	139.9	04.9	200	199.9	07.0	60	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	81.9	02.9	42	141.9	05.0	02	201.9	07.1	62	261.8	09.2
23	23.0	00.8	83	82.9	02.9	43	142.9	05.0	03	202.9	07.1	63	262.8	09.2
24	24.0	00.8	84	83.9	02.9	44	143.9	05.0	04	203.9	07.1	64	263.8	09.2
25	25.0	00.9	85	84.9	03.0	45	144.9	05.1	05	204.9	07.2	65	264.8	09.3
26	26.0	00.9	86	85.9	03.0	46	145.9	05.1	06	205.9	07.2	66	265.8	09.3
27	27.0	00.9	87	86.9	03.0	47	146.9	05.1	07	206.9	07.2	67	266.8	09.3
28	28.0	01.0	88	87.9	03.1	48	147.9	05.2	08	207.9	07.3	68	267.8	09.4
29	29.0	01.0	89	88.9	03.1	49	148.9	05.2	09	208.9	07.3	69	268.8	09.4
30	30.0	01.1	90	89.9	03.1	50	149.9	05.3	10	209.9	07.4	70	269.8	09.5
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	52	151.9	05.3	12	211.9	07.4	72	271.8	09.5
33	33.0	01.2	93	92.9	03.2	53	152.9	05.4	13	212.9	07.5	73	272.8	09.6
34	34.0	01.2	94	93.9	03.3	54	153.9	05.4	14	213.9	07.5	74	273.8	09.6
35	35.0	01.2	95	94.9	03.3	55	154.9	05.4	15	214.9	07.5	75	274.8	09.6
36	36.0	01.3	96	95.9	03.4	56	155.9	05.5	16	215.9	07.6	76	275.8	09.7
37	37.0	01.3	97	96.9	03.4	57	156.9	05.5	17	216.9	07.6	77	276.8	09.7
38	38.0	01.3	98	97.9	03.4	58	157.9	05.5	18	217.9	07.6	78	277.8	09.7
39	39.0	01.4	99	98.9	03.5	59	158.9	05.6	19	218.9	07.7	79	278.8	09.8
40	40.0	01.4	100	99.9	03.5	60	159.9	05.6	20	219.9	07.7	80	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	02	101.9	03.6	62	161.9	05.7	22	221.9	07.8	82	281.8	09.9
43	43.0	01.5	03	102.9	03.6	63	162.9	05.7	23	222.9	07.8	83	282.8	09.9
44	44.0	01.5	04	103.9	03.6	64	163.9	05.7	24	223.9	07.8	84	283.8	09.9
45	45.0	01.6	05	104.9	03.7	65	164.9	05.8	25	224.9	07.9	85	284.8	10.0
46	46.0	01.6	06	105.9	03.7	66	165.9	05.8	26	225.9	07.9	86	285.8	10.0
47	47.0	01.6	07	106.9	03.7	67	166.9	05.8	27	226.9	07.9	87	286.8	10.0
48	48.0	01.7	08	107.9	03.8	68	167.9	05.9	28	227.9	08.0	88	287.8	10.1
49	49.0	01.7	09	108.9	03.8	69	168.9	05.9	29	228.9	08.0	89	288.8	10.1
50	50.0	01.7	10	109.9	03.8	70	169.9	06.0	30	229.9	08.1	90	289.8	10.2
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	12	111.9	03.9	72	171.9	06.0	32	231.9	08.1	92	291.8	10.2
53	53.0	01.8	13	112.9	04.0	73	172.9	06.1	33	232.9	08.2	93	292.8	10.3
54	54.0	01.9	14	113.9	04.0	74	173.9	06.1	34	233.9	08.2	94	293.8	10.3
55	55.0	01.9	15	114.9	04.0	75	174.9	06.1	35	234.9	08.2	95	294.8	10.3
56	56.0	02.0	16	115.9	04.1	76	175.9	06.2	36	235.9	08.3	96	295.8	10.4
57	57.0	02.0	17	116.9	04.1	77	176.9	06.2	37	236.9	08.3	97	296.8	10.4
58	58.0	02.0	18	117.9	04.1	78	177.9	06.2	38	237.9	08.3	98	297.8	10.4
59	59.0	02.1	19	118.9	04.2	79	178.9	06.3	39	238.9	08.4	99	298.8	10.5
60	60.0	02.1	20	119.9	04.2	80	179.9	06.3	40	239.9	08.4	300	299.8	10.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 88 Degrees.

Difference of Latitude and Departure for 3 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.7	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	22	121.8	06.4	82	181.7	09.5	42	241.7	12.7
3	03.0	00.2	63	62.9	03.3	23	122.8	06.4	83	182.7	09.6	43	242.7	12.7
4	04.0	00.2	64	63.9	03.3	24	123.8	06.5	84	183.7	09.6	44	243.7	12.8
5	05.0	00.3	65	64.9	03.4	25	124.8	06.5	85	184.7	09.7	45	244.7	12.8
6	06.0	00.3	66	65.9	03.5	26	125.8	06.6	86	185.7	09.7	46	245.7	12.9
7	07.0	00.4	67	66.9	03.5	27	126.8	06.6	87	186.7	09.8	47	246.7	12.9
8	08.0	00.4	68	67.9	03.6	28	127.8	06.7	88	187.7	09.8	48	247.7	13.0
9	09.0	00.5	69	68.9	03.6	29	128.8	06.8	89	188.7	09.9	49	248.7	13.0
10	10.0	00.5	70	69.9	03.7	30	129.8	06.8	90	189.7	09.9	50	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.6	13.1
12	12.0	00.6	72	71.9	03.8	32	131.8	06.9	92	191.7	10.0	52	251.6	13.2
13	13.0	00.7	73	72.9	03.8	33	132.8	07.0	93	192.7	10.1	53	252.6	13.2
14	14.0	00.7	74	73.9	03.9	34	133.8	07.0	94	193.7	10.1	54	253.6	13.3
15	15.0	00.8	75	74.9	03.9	35	134.8	07.1	95	194.7	10.2	55	254.6	13.3
16	16.0	00.8	76	75.9	04.0	36	135.8	07.1	96	195.7	10.3	56	255.6	13.4
17	17.0	00.9	77	76.9	04.0	37	136.8	07.2	97	196.7	10.3	57	256.6	13.4
18	18.0	00.9	78	77.9	04.1	38	137.8	07.2	98	197.7	10.4	58	257.6	13.5
19	19.0	01.0	79	78.9	04.1	39	138.8	07.3	99	198.7	10.4	59	258.6	13.6
20	20.0	01.0	80	79.9	04.2	40	139.8	07.3	200	199.7	10.5	60	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.1	82	81.9	04.3	42	141.8	07.4	02	201.7	10.6	62	261.6	13.7
23	23.0	01.2	83	82.9	04.3	43	142.8	07.5	03	202.7	10.6	63	262.6	13.8
24	24.0	01.3	84	83.9	04.4	44	143.8	07.5	04	203.7	10.7	64	263.6	13.8
25	25.0	01.3	85	84.9	04.4	45	144.8	07.6	05	204.7	10.7	65	264.6	13.9
26	26.0	01.4	86	85.9	04.5	46	145.8	07.6	06	205.7	10.8	66	265.6	13.9
27	27.0	01.4	87	86.9	04.6	47	146.8	07.7	07	206.7	10.8	67	266.6	14.0
28	28.0	01.5	88	87.9	04.6	48	147.8	07.7	08	207.7	10.9	68	267.6	14.0
29	29.0	01.5	89	88.9	04.7	49	148.8	07.8	09	208.7	10.9	69	268.6	14.1
30	30.0	01.6	90	89.9	04.7	50	149.8	07.9	10	209.7	11.0	70	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	52	151.8	08.0	12	211.7	11.1	72	271.6	14.2
33	33.0	01.7	93	92.9	04.9	53	152.8	08.0	13	212.7	11.1	73	272.6	14.3
34	34.0	01.8	94	93.9	04.9	54	153.8	08.1	14	213.7	11.2	74	273.6	14.3
35	35.0	01.8	95	94.9	05.0	55	154.8	08.1	15	214.7	11.2	75	274.6	14.4
36	35.9	01.9	96	95.9	05.0	56	155.8	08.2	16	215.7	11.3	76	275.6	14.4
37	36.9	01.9	97	96.9	05.1	57	156.8	08.2	17	216.7	11.4	77	276.6	14.5
38	37.9	02.0	98	97.9	05.1	58	157.8	08.3	18	217.7	11.4	78	277.6	14.5
39	38.9	02.0	99	98.9	05.2	59	158.8	08.3	19	218.7	11.5	79	278.6	14.6
40	39.9	02.1	100	99.9	05.2	60	159.8	08.4	20	219.7	11.5	80	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	02	101.9	05.3	62	161.8	08.5	22	221.7	11.6	82	281.6	14.8
43	42.9	02.2	03	102.9	05.4	63	162.8	08.5	23	222.7	11.7	83	282.6	14.8
44	43.9	02.3	04	103.9	05.4	64	163.8	08.6	24	223.7	11.7	84	283.6	14.9
45	44.9	02.4	05	104.9	05.5	65	164.8	08.6	25	224.7	11.8	85	284.6	14.9
46	45.9	02.4	06	105.9	05.5	66	165.8	08.7	26	225.7	11.8	86	285.6	15.0
47	46.9	02.5	07	106.9	05.6	67	166.8	08.7	27	226.7	11.9	87	286.6	15.0
48	47.9	02.5	08	107.8	05.7	68	167.8	08.8	28	227.7	11.9	88	287.6	15.1
49	48.9	02.6	09	108.8	05.7	69	168.8	08.8	29	228.7	12.0	89	288.6	15.1
50	49.9	02.6	10	109.8	05.8	70	169.8	08.9	30	229.7	12.0	90	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	09.0	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	12	111.8	05.9	72	171.8	09.0	32	231.7	12.1	92	291.6	15.3
53	52.9	02.8	13	112.8	05.9	73	172.8	09.1	33	232.7	12.2	93	292.6	15.3
54	53.9	02.8	14	113.8	06.0	74	173.8	09.1	34	233.7	12.2	94	293.6	15.4
55	54.9	02.9	15	114.8	06.0	75	174.8	09.2	35	234.7	12.3	95	294.6	15.4
56	55.9	02.9	16	115.8	06.1	76	175.8	09.2	36	235.7	12.3	96	295.6	15.5
57	56.9	03.0	17	116.8	06.1	77	176.8	09.3	37	236.7	12.4	97	296.6	15.5
58	57.9	03.0	18	117.8	06.2	78	177.8	09.3	38	237.7	12.5	98	297.6	15.6
59	58.9	03.1	19	118.8	06.2	79	178.8	09.4	39	238.7	12.5	99	298.6	15.6
60	59.9	03.1	20	119.8	06.3	80	179.8	09.4	40	239.7	12.6	200	299.6	15.7
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

Difference of Latitude and Departure for 4 Degrees.

D. ft	Lat	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.	D. ft	Lat.	Dep.
1	01.0	00.1	61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
2	02.0	00.1	62	61.9	04.3	22	121.7	08.5	82	181.6	12.7	42	241.4	16.9
3	03.0	00.2	63	62.8	04.4	23	122.7	08.6	83	182.6	12.8	43	242.4	16.9
4	04.0	00.3	64	63.8	04.5	24	123.7	08.6	84	183.6	12.8	44	243.4	17.0
5	05.0	00.3	65	64.8	04.5	25	124.7	08.7	85	184.6	12.9	45	244.4	17.1
6	06.0	00.4	66	65.8	04.6	26	125.7	08.8	86	185.6	13.0	46	245.4	17.1
7	07.0	00.5	67	66.8	04.7	27	126.7	08.9	87	186.6	13.0	47	246.4	17.2
8	08.0	00.6	68	67.8	04.7	28	127.7	08.9	88	187.5	13.1	48	247.4	17.3
9	09.0	00.6	69	68.8	04.8	29	128.7	09.0	89	188.5	13.2	49	248.4	17.4
10	10.0	00.7	70	69.8	04.9	30	129.7	09.1	90	189.5	13.2	50	249.4	17.4
11	11.0	00.8	71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
12	12.0	00.8	72	71.8	05.0	32	131.7	09.2	92	191.5	13.4	52	251.4	17.6
13	13.0	00.9	73	72.8	05.1	33	132.7	09.3	93	192.5	13.5	53	252.4	17.6
14	14.0	01.0	74	73.8	05.2	34	133.7	09.3	94	193.5	13.5	54	253.4	17.7
15	15.0	01.0	75	74.8	05.2	35	134.7	09.4	95	194.5	13.6	55	254.4	17.8
16	16.0	01.1	76	75.8	05.3	36	135.7	09.5	96	195.5	13.7	56	255.4	17.8
17	17.0	01.2	77	76.8	05.4	37	136.7	09.5	97	196.5	13.7	57	256.4	17.9
18	18.0	01.3	78	77.8	05.4	38	137.7	09.6	98	197.5	13.8	58	257.4	18.0
19	19.0	01.3	79	78.8	05.5	39	138.7	09.7	99	198.5	13.9	59	258.4	18.1
20	20.0	01.4	80	79.8	05.6	40	139.7	09.8	200	199.5	13.9	60	259.4	18.1
21	20.9	01.5	81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
22	21.9	01.5	82	81.8	05.7	42	141.7	09.9	02	201.5	14.1	62	261.4	18.3
23	22.9	01.6	83	82.8	05.8	43	142.7	10.0	03	202.5	14.1	63	262.4	18.3
24	23.9	01.7	84	83.8	05.9	44	143.7	10.0	04	203.5	14.2	64	263.4	18.4
25	24.9	01.7	85	84.8	05.9	45	144.7	10.1	05	204.5	14.3	65	264.4	18.5
26	25.9	01.8	86	85.8	06.0	46	145.6	10.2	06	205.5	14.4	66	265.4	18.5
27	26.9	01.9	87	86.8	06.1	47	146.6	10.2	07	206.5	14.4	67	266.4	18.6
28	27.9	02.0	88	87.8	06.1	48	147.6	10.3	08	207.5	14.5	68	267.4	18.7
29	28.9	02.0	89	88.8	06.2	49	148.6	10.4	09	208.5	14.6	69	268.4	18.7
30	29.9	02.1	90	89.8	06.3	50	149.6	10.5	10	209.5	14.6	70	269.4	18.8
31	30.9	02.2	91	90.8	06.4	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	02.2	92	91.8	06.4	52	151.6	10.6	12	211.5	14.8	72	271.3	19.0
33	32.9	02.3	93	92.8	06.5	53	152.6	10.7	13	212.5	14.8	73	272.3	19.0
34	33.9	02.4	94	93.8	06.6	54	153.6	10.7	14	213.5	14.9	74	273.3	19.1
35	34.9	02.4	95	94.8	06.6	55	154.6	10.8	15	214.5	15.0	75	274.3	19.2
36	35.9	02.5	96	95.8	06.7	56	155.6	10.9	16	215.5	15.1	76	275.3	19.2
37	36.9	02.6	97	96.8	06.8	57	156.6	10.9	17	216.5	15.1	77	276.3	19.3
38	37.9	02.7	98	97.8	06.8	58	157.6	11.0	18	217.5	15.2	78	277.3	19.4
39	38.9	02.7	99	98.8	06.9	59	158.6	11.1	19	218.5	15.3	79	278.3	19.4
40	39.9	02.8	100	99.8	07.0	60	159.6	11.2	20	219.5	15.3	80	279.3	19.5
41	40.9	02.9	101	100.8	07.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	02.9	02	101.8	07.1	62	161.6	11.3	22	221.5	15.5	82	281.3	19.7
43	42.9	03.0	03	102.8	07.2	63	162.6	11.4	23	222.5	15.5	83	282.3	19.7
44	43.9	03.1	04	103.8	07.2	64	163.6	11.4	24	223.5	15.6	84	283.3	19.8
45	44.9	03.1	05	104.7	07.3	65	164.6	11.5	25	224.5	15.7	85	284.3	19.9
46	45.9	03.2	06	105.7	07.4	66	165.6	11.6	26	225.5	15.8	86	285.3	19.9
47	46.9	03.3	07	106.7	07.5	67	166.6	11.6	27	226.5	15.8	87	286.3	20.0
48	47.9	03.4	08	107.7	07.5	68	167.6	11.7	28	227.5	15.9	88	287.3	20.1
49	48.9	03.4	09	108.7	07.6	69	168.6	11.8	29	228.5	16.0	89	288.3	20.1
50	49.9	03.5	10	109.7	07.7	70	169.6	11.8	30	229.4	16.0	90	289.3	20.2
51	50.9	03.6	111	110.7	07.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	03.6	12	111.7	07.8	72	171.6	12.0	32	231.4	16.2	92	291.3	20.4
53	52.9	03.7	13	112.7	07.9	73	172.6	12.1	33	232.4	16.2	93	292.3	20.4
54	53.9	03.8	14	113.7	07.9	74	173.6	12.1	34	233.4	16.3	94	293.3	20.5
55	54.9	03.8	15	114.7	08.0	75	174.6	12.2	35	234.4	16.4	95	294.3	20.6
56	55.9	03.9	16	115.7	08.1	76	175.6	12.3	36	235.4	16.4	96	295.3	20.6
57	56.9	04.0	17	116.7	08.2	77	176.6	12.3	37	236.4	16.5	97	296.3	20.7
58	57.9	04.0	18	117.7	08.2	78	177.6	12.4	38	237.4	16.6	98	297.3	20.8
59	58.9	04.1	19	118.7	08.3	79	178.6	12.5	39	238.4	16.7	99	298.3	20.8
60	59.9	04.2	20	119.7	08.4	80	179.6	12.5	40	239.4	16.7	300	299.3	20.9
D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.	D. ft	Dep.	Lat.

for 86 Degrees.

Difference of Latitude and Departure for 5 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.7	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	22	121.5	10.6	82	181.3	15.8	42	241.1	21.1
3	03.0	00.3	63	62.8	05.5	23	122.5	10.7	83	182.3	15.9	43	242.1	21.1
4	04.0	00.3	64	63.8	05.6	24	123.5	10.8	84	183.3	16.0	44	243.1	21.2
5	05.0	00.4	65	64.8	05.7	25	124.5	10.9	85	184.3	16.1	45	244.1	21.3
6	06.0	00.5	66	65.7	05.8	26	125.5	11.0	86	185.3	16.2	46	245.1	21.4
7	07.0	00.6	67	66.7	05.8	27	126.5	11.1	87	186.3	16.3	47	246.1	21.5
8	08.0	00.7	68	67.7	05.9	28	127.5	11.2	88	187.3	16.4	48	247.1	21.6
9	09.0	00.8	69	68.7	06.0	29	128.5	11.3	89	188.3	16.4	49	248.1	21.7
10	10.0	00.9	70	69.7	06.1	30	129.5	11.4	90	189.3	16.5	50	249.1	21.8
11	11.0	01.0	71	70.7	06.2	31	130.5	11.4	91	190.3	16.6	51	250.0	21.8
12	12.0	01.0	72	71.7	06.3	32	131.5	11.5	92	191.3	16.7	52	251.0	21.9
13	12.9	01.1	73	72.7	06.4	33	132.5	11.6	93	192.3	16.8	53	252.0	22.0
14	13.9	01.2	74	73.7	06.5	34	133.5	11.7	94	193.3	16.9	54	253.0	22.1
15	14.9	01.3	75	74.7	06.5	35	134.5	11.7	95	194.3	17.0	55	254.0	22.2
16	15.9	01.4	76	75.7	06.6	36	135.5	11.8	96	195.3	17.1	56	255.0	22.3
17	16.9	01.5	77	76.7	06.7	37	136.5	11.9	97	196.3	17.1	57	256.0	22.4
18	17.9	01.6	78	77.7	06.8	38	137.5	12.0	98	197.2	17.2	58	257.0	22.4
19	18.9	01.7	79	78.7	06.9	39	138.5	12.1	99	198.2	17.3	59	258.0	22.5
20	19.9	01.7	80	79.7	07.0	40	139.5	12.2	200	199.2	17.4	60	259.0	22.6
21	20.9	01.8	81	80.7	07.1	41	140.5	12.3	201	200.2	17.5	201	260.0	22.7
22	21.9	01.9	82	81.7	07.2	42	141.5	12.4	02	201.2	17.6	62	261.0	22.8
23	22.9	02.0	83	82.7	07.2	43	142.5	12.4	03	202.2	17.7	63	262.0	22.9
24	23.9	02.1	84	83.7	07.3	44	143.5	12.5	04	203.2	17.7	64	263.0	23.0
25	24.9	02.2	85	84.7	07.4	45	144.4	12.6	05	204.2	17.8	65	264.0	23.1
26	25.9	02.3	86	85.7	07.5	46	145.4	12.7	06	205.2	17.9	66	265.0	23.1
27	26.9	02.4	87	86.7	07.6	47	146.4	12.8	07	206.2	18.0	67	266.0	23.2
28	27.9	02.4	88	87.7	07.7	48	147.4	12.9	08	207.2	18.1	68	267.0	23.3
29	28.9	02.5	89	88.7	07.8	49	148.4	13.0	09	208.2	18.2	69	268.0	23.4
30	29.9	02.6	90	89.7	07.8	50	149.4	13.1	10	209.2	18.3	70	269.0	23.5
31	30.9	02.7	91	90.7	07.9	51	150.4	13.1	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	52	151.4	13.2	12	211.2	18.4	72	271.0	23.7
33	32.9	02.9	93	92.6	08.1	53	152.4	13.3	13	212.2	18.5	73	272.0	23.8
34	33.9	03.0	94	93.6	08.2	54	153.4	13.4	14	213.2	18.6	74	273.0	23.8
35	34.9	03.1	95	94.6	08.3	55	154.4	13.5	15	214.2	18.7	75	274.0	23.9
36	35.9	03.1	96	95.6	08.4	56	155.4	13.6	16	215.2	18.8	76	275.0	24.0
37	36.9	03.2	97	96.6	08.5	57	156.4	13.7	17	216.2	18.9	77	275.9	24.1
38	37.9	03.3	98	97.6	08.5	58	157.4	13.7	18	217.2	19.0	78	276.9	24.2
39	38.9	03.4	99	98.6	08.6	59	158.4	13.8	19	218.2	19.1	79	277.9	24.3
40	39.8	03.5	100	99.6	08.7	60	159.4	13.9	20	219.2	19.1	80	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.2	281	279.9	24.4
42	41.8	03.7	02	101.6	08.9	62	161.4	14.1	22	221.2	19.3	82	280.9	24.5
43	42.8	03.8	03	102.6	09.0	63	162.4	14.2	23	222.2	19.4	83	281.9	24.6
44	43.8	03.8	04	103.6	09.0	64	163.4	14.3	24	223.1	19.5	84	282.9	24.7
45	44.8	03.9	05	104.6	09.1	65	164.4	14.4	25	224.1	19.6	85	283.9	24.8
46	45.8	04.0	06	105.6	09.2	66	165.4	14.4	26	225.1	19.7	86	284.9	24.9
47	46.8	04.1	07	106.6	09.3	67	166.4	14.5	27	226.1	19.7	87	285.9	25.0
48	47.8	04.2	08	107.6	09.4	68	167.4	14.6	28	227.1	19.8	88	286.9	25.1
49	48.8	04.3	09	108.6	09.5	69	168.4	14.7	29	228.1	19.9	89	287.9	25.1
50	49.8	04.4	10	109.6	09.6	70	169.4	14.8	30	229.1	20.0	90	288.9	25.2
51	50.8	04.4	111	110.6	09.7	171	170.4	14.9	231	230.1	20.1	291	289.9	25.3
52	51.8	04.5	12	111.6	09.7	72	171.3	15.0	32	231.1	20.2	92	290.9	25.4
53	52.8	04.6	13	112.6	09.8	73	172.3	15.1	33	232.1	20.3	93	291.9	25.5
54	53.8	04.7	14	113.6	09.9	74	173.3	15.1	34	233.1	20.4	94	292.9	25.6
55	54.8	04.8	15	114.6	10.0	75	174.3	15.2	35	234.1	20.4	95	293.9	25.7
56	55.8	04.9	16	115.6	10.1	76	175.3	15.3	36	235.1	20.5	96	294.9	25.8
57	56.8	05.0	17	116.6	10.2	77	176.3	15.4	37	236.1	20.6	97	295.9	25.8
58	57.8	05.1	18	117.6	10.3	78	177.3	15.5	38	237.1	20.7	98	296.9	25.9
59	58.8	05.1	19	118.5	10.4	79	178.3	15.6	39	238.1	20.8	99	297.9	26.0
60	59.8	05.2	20	119.5	10.4	80	179.3	15.7	40	239.1	20.9	300	298.9	26.1
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 85 Degrees.

Difference of Latitude and Departure for 6 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.1	61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	02.0	00.2	62	61.7	06.5	22	121.3	12.7	82	181.0	19.0	42	240.7	25.3
3	03.0	00.3	63	62.7	06.6	23	122.3	12.9	83	182.0	19.1	43	241.7	25.4
4	04.0	00.4	64	63.6	06.7	24	123.3	13.0	84	183.0	19.2	44	242.7	25.5
5	05.0	00.5	65	64.6	06.8	25	124.3	13.1	85	184.0	19.3	45	243.7	25.6
6	06.0	00.6	66	65.6	06.9	26	125.3	13.2	86	185.0	19.4	46	244.6	25.7
7	07.0	00.7	67	66.6	07.0	27	126.3	13.3	87	186.0	19.5	47	245.6	25.8
8	08.0	00.8	68	67.6	07.1	28	127.3	13.4	88	187.0	19.6	48	246.6	25.9
9	08.9	00.9	69	68.6	07.2	29	128.3	13.5	89	188.0	19.8	49	247.6	26.0
10	09.9	01.0	70	69.6	07.3	30	129.3	13.6	90	189.0	19.9	50	248.6	26.1
11	10.9	01.1	71	70.6	07.4	131	130.3	13.7	191	189.9	20.0	251	249.6	26.2
12	11.9	01.3	72	71.6	07.5	32	131.3	13.8	92	190.9	20.1	52	250.6	26.3
13	12.9	01.4	73	72.6	07.6	33	132.3	13.9	93	191.9	20.2	53	251.6	26.4
14	13.9	01.5	74	73.6	07.7	34	133.3	14.0	94	192.9	20.3	54	252.6	26.5
15	14.9	01.6	75	74.6	07.8	35	134.3	14.1	95	193.9	20.4	55	253.6	26.6
16	15.9	01.7	76	75.6	07.9	36	135.3	14.2	96	194.9	20.5	56	254.6	26.8
17	16.9	01.8	77	76.6	08.0	37	136.2	14.3	97	195.9	20.6	57	255.6	26.9
18	17.9	01.9	78	77.6	08.1	38	137.2	14.4	98	196.9	20.7	58	256.6	27.0
19	18.9	02.0	79	78.6	08.3	39	138.2	14.5	99	197.9	20.8	59	257.6	27.1
20	19.9	02.1	80	79.6	08.4	40	139.2	14.6	200	198.9	20.9	60	258.6	27.2
21	20.9	02.2	81	80.6	08.5	141	140.2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	02.3	82	81.5	08.6	42	141.2	14.8	02	200.9	21.1	62	260.6	27.4
23	22.9	02.4	83	82.5	08.7	43	142.2	14.9	03	201.9	21.2	63	261.6	27.5
24	23.9	02.5	84	83.5	08.8	44	143.2	15.0	04	202.9	21.3	64	262.5	27.6
25	24.9	02.6	85	84.5	08.9	45	144.2	15.2	05	203.9	21.4	65	263.5	27.7
26	25.9	02.7	86	85.5	09.0	46	145.2	15.3	06	204.9	21.5	66	264.5	27.8
27	26.9	02.8	87	86.5	09.1	47	146.2	15.4	07	205.9	21.6	67	265.5	27.9
28	27.8	02.9	88	87.5	09.2	48	147.2	15.5	08	206.9	21.7	68	266.5	28.0
29	28.8	03.0	89	88.5	09.3	49	148.2	15.6	09	207.9	21.8	69	267.5	28.1
30	29.8	03.1	90	89.5	09.4	50	149.2	15.7	10	208.8	21.9	70	268.5	28.2
31	30.8	03.2	91	90.5	09.5	151	150.2	15.8	211	209.8	22.0	271	269.5	28.3
32	31.8	03.3	92	91.5	09.6	52	151.2	15.9	12	210.8	22.2	72	270.5	28.4
33	32.8	03.4	93	92.5	09.7	53	152.2	16.0	13	211.8	22.3	73	271.5	28.5
34	33.8	03.6	94	93.5	09.8	54	153.2	16.1	14	212.8	22.4	74	272.5	28.6
35	34.8	03.7	95	94.5	09.9	55	154.1	16.2	15	213.8	22.5	75	273.5	28.7
36	35.8	03.8	96	95.5	10.0	56	155.1	16.3	16	214.8	22.6	76	274.5	28.8
37	36.8	03.9	97	96.5	10.1	57	156.1	16.4	17	215.8	22.7	77	275.5	28.9
38	37.8	04.0	98	97.5	10.2	58	157.1	16.5	18	216.8	22.8	78	276.5	29.1
39	38.8	04.1	99	98.5	10.3	59	158.1	16.6	19	217.8	22.9	79	277.5	29.2
40	39.8	04.2	100	99.5	10.5	60	159.1	16.7	20	218.8	23.0	80	278.5	29.3
41	40.8	04.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	04.4	02	101.4	10.7	62	161.1	16.9	22	220.8	23.2	82	280.4	29.5
43	42.8	04.5	03	102.4	10.8	63	162.1	17.0	23	221.8	23.3	83	281.4	29.6
44	43.8	04.6	04	103.4	10.9	64	163.1	17.1	24	222.8	23.4	84	282.4	29.7
45	44.8	04.7	05	104.4	11.0	65	164.1	17.2	25	223.8	23.5	85	283.4	29.8
46	45.7	04.8	06	105.4	11.1	66	165.1	17.3	26	224.8	23.6	86	284.4	29.9
47	46.7	04.9	07	106.4	11.2	67	166.1	17.5	27	225.8	23.7	87	285.4	30.0
48	47.7	05.0	08	107.4	11.3	68	167.1	17.6	28	226.7	23.8	88	286.4	30.1
49	48.7	05.1	09	108.4	11.4	69	168.1	17.7	29	227.7	23.9	89	287.4	30.2
50	49.7	05.2	10	109.4	11.5	70	169.1	17.8	30	228.7	24.0	90	288.4	30.3
51	50.7	05.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	05.4	12	111.4	11.7	72	171.1	18.0	32	230.7	24.2	92	290.4	30.5
53	52.7	05.5	13	112.4	11.8	73	172.0	18.1	33	231.7	24.3	93	291.4	30.6
54	53.7	05.6	14	113.4	11.9	74	173.0	18.2	34	232.7	24.5	94	292.4	30.7
55	54.7	05.7	15	114.4	12.0	75	174.0	18.3	35	233.7	24.6	95	293.4	30.8
56	55.7	05.9	16	115.4	12.1	76	175.0	18.4	36	234.7	24.7	96	294.4	30.9
57	56.7	06.0	17	116.4	12.2	77	176.0	18.5	37	235.7	24.8	97	295.4	31.0
58	57.7	06.1	18	117.4	12.3	78	177.0	18.6	38	236.7	24.9	98	296.4	31.1
59	58.7	06.2	19	118.3	12.4	79	178.0	18.7	39	237.7	25.0	99	297.4	31.2
60	59.7	06.3	20	119.3	12.5	80	179.0	18.8	40	238.7	25.1	300	298.4	31.4
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 84 Degrees.

Difference of Latitude and Departure for 7 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.1	61	60.5	07.4	121	120.1	14.7	181	179.6	22.0	241	239.2	29.3
2	02.0	00.2	62	61.5	07.5	22	121.1	14.9	82	180.6	22.2	42	240.2	29.5
3	03.0	00.4	63	62.5	07.7	23	122.1	15.0	83	181.6	22.3	43	241.2	29.6
4	04.0	00.5	64	63.5	07.8	24	123.1	15.1	84	182.6	22.4	44	242.2	29.7
5	05.0	00.6	65	64.5	07.9	25	124.1	15.2	85	183.6	22.5	45	243.2	29.8
6	06.0	00.7	66	65.5	08.0	26	125.1	15.3	86	184.6	22.7	46	244.1	29.9
7	06.9	00.9	67	66.5	08.2	27	126.0	15.5	87	185.6	22.8	47	245.1	30.1
8	07.9	01.0	68	67.5	08.3	28	127.0	15.6	88	186.6	22.9	48	246.1	30.2
9	08.9	01.1	69	68.5	08.4	29	128.0	15.7	89	187.6	23.0	49	247.1	30.3
10	09.9	01.2	70	69.5	08.5	30	129.0	15.8	90	188.6	23.1	50	248.1	30.4
11	10.9	01.3	71	70.5	08.6	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	01.5	72	71.5	08.8	32	131.0	16.1	92	190.6	23.4	52	250.1	30.7
13	12.9	01.6	73	72.5	08.9	33	132.0	16.2	93	191.6	23.5	53	251.1	30.8
14	13.9	01.7	74	73.4	09.0	34	133.0	16.3	94	192.5	23.6	54	252.1	30.9
15	14.9	01.8	75	74.4	09.1	35	134.0	16.4	95	193.5	23.7	55	253.1	31.0
16	15.9	01.9	76	75.4	09.3	36	135.0	16.6	96	194.5	23.9	56	254.1	31.2
17	16.9	02.1	77	76.4	09.4	37	136.0	16.7	97	195.5	24.0	57	255.1	31.3
18	17.9	02.2	78	77.4	09.5	38	137.0	16.8	98	196.5	24.1	58	256.1	31.4
19	18.9	02.3	79	78.4	09.6	39	138.0	16.9	99	197.5	24.2	59	257.1	31.5
20	19.9	02.4	80	79.4	09.7	40	139.0	17.1	200	198.5	24.4	60	258.1	31.7
21	20.8	02.6	81	80.4	09.9	141	139.9	17.2	201	199.5	24.5	261	259.0	31.8
22	21.8	02.7	82	81.4	10.0	42	140.9	17.3	02	200.5	24.6	62	260.0	31.9
23	22.8	02.8	83	82.4	10.1	43	141.9	17.4	03	201.5	24.7	63	261.0	32.0
24	23.8	02.9	84	83.4	10.2	44	142.9	17.5	04	202.5	24.8	64	262.0	32.1
25	24.8	03.0	85	84.4	10.4	45	143.9	17.7	05	203.5	25.0	65	263.0	32.3
26	25.8	03.2	86	85.4	10.5	46	144.9	17.8	06	204.5	25.1	66	264.0	32.4
27	26.8	03.3	87	86.3	10.6	47	145.9	17.9	07	205.4	25.2	67	265.0	32.5
28	27.8	03.4	88	87.3	10.7	48	146.9	18.0	08	206.4	25.3	68	266.0	32.6
29	28.8	03.5	89	88.3	10.8	49	147.9	18.1	09	207.4	25.4	69	267.0	32.8
30	29.8	03.7	90	89.3	11.0	50	148.9	18.3	10	208.4	25.6	70	268.0	32.9
31	30.8	03.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	03.9	92	91.3	11.2	52	150.9	18.5	12	210.4	25.8	72	270.0	33.1
33	32.8	04.0	93	92.3	11.3	53	151.9	18.6	13	211.4	25.9	73	271.0	33.2
34	33.7	04.1	94	93.3	11.5	54	152.8	18.7	14	212.4	26.1	74	271.9	33.4
35	34.7	04.3	95	94.3	11.6	55	153.8	18.9	15	213.4	26.2	75	272.9	33.5
36	35.7	04.4	96	95.3	11.7	56	154.8	19.0	16	214.4	26.3	76	273.9	33.6
37	36.7	04.5	97	96.3	11.8	57	155.8	19.1	17	215.4	26.4	77	274.9	33.7
38	37.7	04.6	98	97.3	11.9	58	156.8	19.2	18	216.4	26.5	78	275.9	33.9
39	38.7	04.8	99	98.3	12.1	59	157.8	19.4	19	217.4	26.7	79	276.9	34.0
40	39.7	04.9	100	99.3	12.2	60	158.8	19.5	20	218.4	26.8	80	277.4	34.1
41	40.7	05.0	101	100.2	12.3	161	159.8	19.6	221	219.3	26.9	281	278.9	34.2
42	41.7	05.1	02	101.2	12.4	62	160.8	19.7	22	220.3	27.0	82	279.9	34.3
43	42.7	05.2	03	102.2	12.5	63	161.8	19.8	23	221.3	27.2	83	280.9	34.5
44	43.7	05.4	04	103.2	12.7	64	162.8	20.0	24	222.3	27.3	84	281.9	34.6
45	44.7	05.5	05	104.2	12.8	65	163.8	20.1	25	223.3	27.4	85	282.9	34.7
46	45.7	05.6	06	105.2	12.9	66	164.8	20.2	26	224.3	27.5	86	283.9	34.8
47	46.6	05.7	07	106.2	13.0	67	165.7	20.3	27	225.3	27.6	87	284.8	34.9
48	47.6	05.8	08	107.2	13.1	68	166.7	20.5	28	226.3	27.8	88	285.8	35.1
49	48.6	06.0	09	108.2	13.3	69	167.7	20.6	29	227.3	27.9	89	286.8	35.2
50	49.6	06.1	10	109.2	13.4	70	168.7	20.7	30	228.3	28.0	90	287.8	35.3
51	50.6	06.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.1	291	288.8	35.4
52	51.6	06.3	12	111.2	13.6	72	170.7	20.9	32	230.3	28.3	92	289.8	35.5
53	52.6	06.5	13	112.2	13.8	73	171.7	21.1	33	231.3	28.4	93	290.8	35.7
54	53.6	06.6	14	113.1	13.9	74	172.7	21.2	34	232.2	28.5	94	291.8	35.8
55	54.6	06.7	15	114.1	14.0	75	173.7	21.3	35	233.2	28.6	95	292.8	35.9
56	55.6	06.8	16	115.1	14.1	76	174.7	21.4	36	234.2	28.7	96	293.8	36.0
57	56.6	06.9	17	116.1	14.2	77	175.7	21.6	37	235.2	28.9	97	294.8	36.2
58	57.6	07.1	18	117.1	14.4	78	176.7	21.7	38	236.2	29.0	98	295.8	36.3
59	58.6	07.2	19	118.1	14.5	79	177.7	21.8	39	237.2	29.1	99	296.8	36.4
60	59.6	07.3	20	119.1	14.6	80	178.7	21.9	40	238.2	29.2	300	297.8	36.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 83 Degrees.

Difference of Latitude and Departure for 8 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.1	61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	02.0	00.3	62	61.4	08.6	22	120.8	17.0	82	180.2	25.3	42	239.7	33.7
3	03.0	00.4	63	62.4	08.8	23	121.8	17.1	83	181.2	25.5	43	240.6	33.8
4	04.0	00.6	64	63.4	08.9	24	122.8	17.3	84	182.2	25.6	44	241.6	34.0
5	05.0	00.7	65	64.4	09.0	25	123.8	17.4	85	183.2	25.8	45	242.6	34.1
6	05.9	00.8	66	65.4	09.2	26	124.8	17.5	86	184.2	25.9	46	243.6	34.2
7	06.9	01.0	67	66.4	09.3	27	125.8	17.7	87	185.2	26.0	47	244.6	34.4
8	07.9	01.1	68	67.3	09.5	28	126.8	17.8	88	186.2	26.2	48	245.6	34.5
9	08.9	01.3	69	68.3	09.6	29	127.7	18.0	89	187.2	26.3	49	246.6	34.7
10	09.9	01.4	70	69.3	09.7	30	128.7	18.1	90	188.2	26.4	50	247.6	34.8
11	10.9	01.5	71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	01.7	72	71.3	10.0	32	130.7	18.4	92	190.1	26.7	52	249.6	35.1
13	12.9	01.8	73	72.3	10.2	33	131.7	18.5	93	191.1	26.9	53	250.5	35.2
14	13.9	01.9	74	73.3	10.3	34	132.7	18.7	94	192.1	27.0	54	251.5	35.4
15	14.9	02.1	75	74.3	10.4	35	133.7	18.8	95	193.1	27.1	55	252.5	35.5
16	15.8	02.2	76	75.3	10.6	36	134.7	18.9	96	194.1	27.3	56	253.5	35.6
17	16.8	02.4	77	76.3	10.7	37	135.7	19.1	97	195.1	27.4	57	254.5	35.8
18	17.8	02.5	78	77.2	10.9	38	136.7	19.2	98	196.1	27.6	58	255.5	35.9
19	18.8	02.6	79	78.2	11.0	39	137.7	19.3	99	197.1	27.7	59	256.5	36.1
20	19.8	02.8	80	79.2	11.1	40	138.6	19.5	200	198.1	27.8	60	257.5	36.2
21	20.8	02.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	03.1	82	81.2	11.4	42	140.6	19.8	02	200.0	28.1	62	259.5	36.5
23	22.8	03.2	83	82.2	11.6	43	141.6	19.9	03	201.0	28.3	63	260.4	36.6
24	23.8	03.3	84	83.2	11.7	44	142.6	20.0	04	202.0	28.4	64	261.4	36.7
25	24.8	03.5	85	84.2	11.8	45	143.6	20.2	05	203.0	28.5	65	262.4	36.9
26	25.7	03.6	86	85.2	12.0	46	144.6	20.3	06	204.0	28.7	66	263.4	37.0
27	26.7	03.8	87	86.2	12.1	47	145.6	20.5	07	205.0	28.8	67	264.4	37.2
28	27.7	03.9	88	87.1	12.2	48	146.6	20.6	08	206.0	29.0	68	265.4	37.3
29	28.7	04.0	89	88.1	12.4	49	147.6	20.7	09	207.0	29.1	69	266.4	37.4
30	29.7	04.2	90	89.1	12.5	50	148.5	20.9	10	208.0	29.2	70	267.4	37.6
31	30.7	04.3	91	90.1	12.7	151	149.5	21.0	211	209.0	29.4	271	268.4	37.7
32	31.7	04.5	92	91.1	12.8	52	150.5	21.2	12	209.9	29.5	72	269.4	37.9
33	32.7	04.6	93	92.1	12.9	53	151.5	21.3	13	210.9	29.6	73	270.4	38.0
34	33.7	04.7	94	93.1	13.1	54	152.5	21.4	14	211.9	29.8	74	271.3	38.1
35	34.7	04.9	95	94.1	13.2	55	153.5	21.6	15	212.9	29.9	75	272.3	38.3
36	35.7	05.0	96	95.1	13.4	56	154.5	21.7	16	213.9	30.1	76	273.3	38.4
37	36.6	05.2	97	96.1	13.5	57	155.5	21.9	17	214.9	30.2	77	274.3	38.6
38	37.6	05.4	98	97.0	13.6	58	156.5	22.0	18	215.9	30.3	78	275.3	38.7
39	38.6	05.5	99	98.0	13.8	59	157.5	22.1	19	216.9	30.5	79	276.3	38.8
40	39.6	05.6	100	99.0	13.9	60	158.4	22.3	20	217.9	30.6	80	277.3	39.0
41	40.6	05.7	101	100.0	14.1	161	159.4	22.4	221	218.9	30.8	281	278.3	39.1
42	41.6	05.8	02	101.0	14.2	62	160.4	22.6	22	219.8	30.9	82	279.3	39.3
43	42.6	06.0	03	102.0	14.3	63	161.4	22.7	23	220.8	31.0	83	280.3	39.4
44	43.6	06.1	04	103.0	14.5	64	162.4	22.8	24	221.8	31.2	84	281.2	39.5
45	44.6	06.3	05	104.0	14.6	65	163.4	23.0	25	222.8	31.3	85	282.2	39.7
46	45.6	06.4	06	105.0	14.8	66	164.4	23.1	26	223.8	31.5	86	283.2	39.8
47	46.5	06.5	07	106.0	14.9	67	165.4	23.2	27	224.8	31.6	87	284.2	40.0
48	47.5	06.7	08	107.0	15.0	68	166.4	23.4	28	225.8	31.7	88	285.2	40.1
49	48.5	06.8	09	107.9	15.2	69	167.4	23.5	29	226.8	31.9	89	286.2	40.2
50	49.5	07.0	10	108.9	15.3	70	168.4	23.7	30	227.8	32.0	90	287.2	40.4
51	50.5	07.1	111	109.9	15.5	171	169.3	23.8	231	228.8	32.2	291	288.2	40.5
52	51.5	07.2	12	110.9	15.6	72	170.3	23.9	32	229.7	32.3	92	289.2	40.6
53	52.5	07.4	13	111.9	15.7	73	171.3	24.1	33	230.7	32.4	93	290.2	40.8
54	53.5	07.5	14	112.9	15.9	74	172.3	24.2	34	231.7	32.6	94	291.1	40.9
55	54.5	07.7	15	113.9	16.0	75	173.3	24.4	35	232.7	32.7	95	292.1	41.1
56	55.5	07.8	16	114.9	16.1	76	174.3	24.5	36	233.7	32.9	96	293.1	41.2
57	56.4	07.9	17	115.9	16.3	77	175.3	24.6	37	234.7	33.0	97	294.1	41.3
58	57.4	08.1	18	116.9	16.4	78	176.3	24.7	38	235.7	33.1	98	295.1	41.5
59	58.4	08.2	19	117.8	16.6	79	177.3	24.9	39	236.7	33.3	99	296.1	41.6
60	59.4	08.4	20	118.8	16.7	80	178.3	25.1	40	237.7	33.4	300	297.1	41.8
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 82 Degrees.

Difference of Latitude and Departure for 9 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	9.7	22	120.5	19.1	82	179.8	28.5	42	239.0	37.8
3	03.0	00.5	63	62.2	09.9	23	121.5	19.2	83	180.7	28.6	43	240.0	38.0
4	04.0	00.6	64	63.2	10.0	24	122.5	19.4	84	181.7	28.8	44	241.0	38.2
5	04.9	00.8	65	64.2	10.2	25	123.5	19.6	85	182.7	28.9	45	242.0	38.3
6	05.9	00.9	66	65.2	10.3	26	124.5	19.7	86	183.7	29.1	46	243.0	38.5
7	06.9	01.1	67	66.2	10.5	27	125.4	19.9	87	184.7	29.2	47	244.0	38.6
8	07.9	01.3	68	67.2	10.6	28	126.4	20.0	88	185.7	29.4	48	244.9	38.8
9	08.9	01.4	69	68.2	10.8	29	127.4	20.2	89	186.7	29.6	49	245.9	38.9
10	09.0	01.6	70	69.1	10.0	30	128.4	20.3	90	187.7	29.7	50	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.7	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	32	130.4	20.6	92	189.6	30.0	52	248.9	39.4
13	12.9	02.0	73	72.1	11.4	33	131.4	20.8	93	190.6	30.2	53	249.9	39.6
14	13.8	02.2	74	73.1	11.6	34	132.4	21.0	94	191.6	30.3	54	250.9	39.7
15	14.8	02.3	75	74.1	11.7	35	133.3	21.1	95	192.6	30.5	55	251.9	39.9
16	15.8	02.5	76	75.1	11.9	36	134.3	21.3	96	193.6	30.7	56	252.9	40.0
17	16.8	02.7	77	76.1	12.0	37	135.3	21.4	97	194.6	30.8	57	253.8	40.2
18	17.8	02.8	78	77.0	12.2	38	136.3	21.6	98	195.6	31.0	58	254.8	40.4
19	18.8	03.0	79	78.0	12.4	39	137.3	21.7	99	196.6	31.1	59	255.8	40.5
20	19.8	03.1	80	79.0	12.5	40	138.3	21.9	200	197.5	31.3	60	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	42	140.3	22.2	02	199.5	31.6	62	258.8	41.0
23	22.7	03.6	83	82.0	13.0	43	141.2	22.4	03	200.5	31.7	63	259.8	41.1
24	23.7	03.8	84	83.0	13.1	44	142.2	22.5	04	201.5	31.9	64	260.8	41.3
25	24.7	03.9	85	84.0	13.3	45	143.2	22.7	05	202.5	32.1	65	261.7	41.4
26	25.7	04.1	86	84.9	13.5	46	144.2	22.8	06	203.5	32.2	66	262.7	41.6
27	26.7	04.2	87	85.9	13.6	47	145.2	23.0	07	204.5	32.4	67	263.7	41.8
28	27.7	04.4	88	86.9	13.8	48	146.2	23.1	08	205.4	32.5	68	264.7	41.9
29	28.6	04.5	89	87.9	13.9	49	147.2	23.3	09	206.4	32.7	69	265.7	42.1
30	29.6	04.7	90	88.9	14.1	50	148.2	23.5	10	207.4	32.8	70	266.7	42.2
31	30.6	04.8	191	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	52	150.1	23.8	12	209.4	33.2	72	268.6	42.5
33	32.6	05.2	93	91.9	14.5	53	151.1	23.9	13	210.4	33.3	73	269.6	42.7
34	33.6	05.3	94	92.8	14.7	54	152.1	24.1	14	211.4	33.5	74	270.6	42.9
35	34.6	05.5	95	93.8	14.9	55	153.1	24.2	15	212.4	33.6	75	271.6	43.0
36	35.6	05.6	96	94.8	15.0	56	154.1	24.4	16	213.3	33.8	76	272.6	43.2
37	36.5	05.8	97	95.8	15.2	57	155.1	24.6	17	214.3	33.9	77	273.6	43.3
38	37.5	05.9	98	96.8	15.3	58	156.1	24.7	18	215.3	34.1	78	274.6	43.5
39	38.5	06.1	99	97.8	15.5	59	157.0	24.9	19	216.3	34.3	79	275.6	43.6
40	39.5	06.3	100	98.8	15.6	60	158.0	25.0	20	217.3	34.4	80	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	43.9
42	41.5	06.6	02	100.7	16.0	62	160.0	25.3	22	219.3	34.7	82	278.5	44.1
43	42.5	06.7	03	101.7	16.1	63	161.0	25.5	23	220.3	34.9	83	279.5	44.3
44	43.5	06.9	04	102.7	16.3	64	162.0	25.6	24	221.2	35.0	84	280.5	44.4
45	44.4	07.0	05	103.7	16.4	65	163.0	25.8	25	222.2	35.2	85	281.5	44.6
46	45.4	07.2	06	104.7	16.6	66	164.0	26.0	26	223.2	35.3	86	282.5	44.7
47	46.4	07.4	07	105.7	16.7	67	164.0	26.1	27	224.2	35.5	87	283.5	44.9
48	47.4	07.5	08	106.7	16.9	68	165.0	26.3	28	225.2	35.7	88	284.5	45.0
49	48.4	07.7	09	107.7	17.0	69	166.0	26.4	29	226.2	35.8	89	285.4	45.2
50	49.4	07.8	10	108.6	17.2	70	167.9	26.6	30	227.2	36.0	90	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.7	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	12	110.6	17.5	72	169.9	26.9	32	229.1	36.3	92	288.4	45.7
53	52.3	08.3	13	111.6	17.7	73	170.9	27.1	33	230.1	36.4	93	289.4	45.8
54	53.3	08.4	14	112.6	17.8	74	171.9	27.2	34	231.1	36.6	94	290.4	46.0
55	54.3	08.6	15	113.6	18.0	75	172.8	27.4	35	232.1	36.8	95	291.4	46.1
56	55.3	08.8	16	114.6	18.1	76	173.8	27.5	36	233.1	36.9	96	292.4	46.3
57	56.3	08.9	17	115.6	18.3	77	174.8	27.7	37	234.1	37.1	97	293.3	46.5
58	57.3	09.1	18	116.5	18.5	78	175.8	27.8	38	235.1	37.2	98	294.3	46.6
59	58.3	09.2	19	117.5	18.6	79	176.8	28.0	39	236.1	37.4	99	295.3	46.8
60	59.3	09.4	20	118.5	18.8	80	177.8	28.2	40	237.0	37.5	300	296.3	46.9
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

D d for 81 Degrees.

Difference of Latitude and Departure for 10 Degrees:

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.2	61	60.1	10.6	121	119.2	21.0	181	178.2	31.4	241	237.3	41.8
2	02.0	00.3	62	61.1	10.8	22	120.1	21.2	82	179.2	31.6	42	238.3	42.0
3	03.0	00.5	63	62.0	10.9	23	121.1	21.3	83	180.2	31.7	43	239.3	42.1
4	03.9	00.7	64	63.0	11.1	24	122.1	21.5	84	181.2	31.9	44	240.3	42.3
5	04.9	00.9	65	64.0	11.2	25	123.1	21.7	85	182.2	32.1	45	241.3	42.5
6	05.9	01.0	66	65.0	11.4	26	124.1	21.8	86	183.2	32.3	46	242.3	42.7
7	06.9	01.2	67	66.0	11.6	27	125.1	22.0	87	184.2	32.4	47	243.2	42.8
8	07.9	01.4	68	67.0	11.8	28	126.1	22.2	88	185.1	32.6	48	244.2	43.0
9	08.9	01.6	69	68.0	12.0	29	127.0	22.4	89	186.1	32.8	49	245.2	43.2
10	09.8	01.7	70	68.9	12.1	30	128.0	22.5	90	187.1	32.9	50	246.2	43.4
11	10.8	01.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.1	251	247.2	43.5
12	11.8	02.1	72	70.9	12.5	32	130.0	22.9	92	189.1	33.3	52	248.2	43.7
13	12.8	02.3	73	71.9	12.7	33	131.0	23.1	93	190.1	33.5	53	249.2	43.9
14	13.8	02.4	74	72.9	12.8	34	132.0	23.2	94	191.0	33.6	54	250.1	44.0
15	14.8	02.6	75	73.9	13.0	35	132.9	23.4	95	192.0	33.8	55	251.1	44.2
16	15.8	02.8	76	74.8	13.2	36	133.9	23.6	96	193.0	34.0	56	252.1	44.4
17	16.7	02.9	77	75.8	13.4	37	134.9	23.8	97	194.0	34.2	57	253.1	44.6
18	17.7	03.1	78	76.8	13.5	38	135.9	23.9	98	195.0	34.3	58	254.1	44.7
19	18.7	03.3	79	77.8	13.7	39	136.9	24.1	99	196.0	34.5	59	255.1	44.9
20	19.7	03.5	80	78.8	13.9	40	137.9	24.3	200	197.0	34.7	60	256.0	45.1
21	20.7	03.6	81	79.8	14.0	141	138.9	24.4	201	197.9	34.9	261	257.0	45.3
22	21.7	03.8	82	80.8	14.2	42	139.8	24.6	02	198.9	35.0	62	258.0	45.4
23	22.7	04.0	83	81.7	14.4	43	140.8	24.8	03	199.9	35.2	63	259.0	45.6
24	23.6	04.2	84	82.7	14.6	44	141.8	25.0	04	200.9	35.4	64	260.0	45.8
25	24.6	04.3	85	83.7	14.7	45	142.8	25.1	05	201.9	35.5	65	261.0	46.0
26	25.6	04.5	86	84.7	14.9	46	143.8	25.3	06	202.9	35.7	66	262.0	46.1
27	26.6	04.7	87	85.7	15.1	47	144.8	25.5	07	203.9	35.9	67	262.9	46.3
28	27.6	04.9	88	86.7	15.3	48	145.7	25.7	08	204.9	36.1	68	263.9	46.5
29	28.6	05.0	89	87.6	15.4	49	146.7	25.8	09	205.8	36.2	69	264.9	46.6
30	29.5	05.2	90	88.6	15.6	50	147.7	26.0	10	206.8	36.4	70	265.9	46.8
31	30.5	05.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.0
32	31.5	05.5	92	90.6	16.0	52	149.7	26.4	12	208.8	36.8	72	267.9	47.2
33	32.5	05.7	93	91.6	16.1	53	150.7	26.5	13	209.8	36.9	73	268.9	47.3
34	33.5	05.9	94	92.6	16.3	54	151.7	26.7	14	210.7	37.1	74	269.8	47.5
35	34.5	06.1	95	93.6	16.5	55	152.6	26.9	15	211.7	37.3	75	270.8	47.7
36	35.5	06.2	96	94.5	16.6	56	153.6	27.1	16	212.7	37.5	76	271.8	47.9
37	36.4	06.4	97	95.5	16.8	57	154.6	27.2	17	213.7	37.6	77	272.8	48.0
38	37.4	06.6	98	96.5	17.0	58	155.6	27.4	18	214.7	37.8	78	273.8	48.2
39	38.4	06.8	99	97.5	17.2	59	156.6	27.6	19	215.7	38.0	79	274.8	48.4
40	39.4	06.9	100	98.5	17.3	60	157.6	27.7	20	216.7	38.1	80	275.7	48.6
41	40.4	07.1	101	99.5	17.5	161	158.6	27.9	221	217.6	38.3	281	276.7	48.7
42	41.4	07.3	02	100.4	17.7	62	159.5	28.1	22	218.6	38.5	82	277.7	48.9
43	42.3	07.5	03	101.4	17.9	63	160.5	28.3	23	219.6	38.7	83	278.7	49.1
44	43.3	07.6	04	102.4	18.0	64	161.5	28.4	24	220.6	38.8	84	279.7	49.2
45	44.3	07.8	05	103.4	18.2	65	162.5	28.6	25	221.6	39.0	85	280.7	49.4
46	45.3	08.0	06	104.4	18.4	66	163.5	29.8	26	222.6	39.2	86	281.6	49.6
47	46.3	08.1	07	105.4	18.6	67	164.5	29.0	27	223.5	39.4	87	282.6	49.8
48	47.3	08.3	08	106.4	18.7	68	165.4	29.1	28	224.5	39.5	88	283.6	49.9
49	48.3	08.5	09	107.3	18.9	69	166.4	29.3	29	225.5	39.7	89	284.6	50.1
50	49.2	08.7	10	108.3	19.1	70	167.4	29.5	30	226.5	39.9	90	285.6	50.3
51	50.2	08.8	111	109.3	19.2	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	09.0	12	110.3	19.4	72	169.4	29.8	32	228.5	40.2	92	287.6	50.6
53	52.2	09.2	13	111.3	19.6	73	170.4	30.0	33	229.5	40.4	93	288.5	50.8
54	53.2	09.4	14	112.3	19.8	74	171.4	30.2	34	230.4	40.6	94	289.5	51.0
55	54.2	09.5	15	113.3	19.9	75	172.3	30.3	35	231.4	40.7	95	290.5	51.2
56	55.1	09.7	16	114.2	20.1	76	173.3	30.5	36	232.4	40.9	96	291.5	51.3
57	56.1	09.9	17	115.2	20.3	77	174.3	30.7	37	233.4	41.1	97	292.5	51.5
58	57.1	10.1	18	116.2	20.5	78	175.3	30.9	38	234.4	41.3	98	293.5	51.7
59	58.1	10.2	19	117.2	20.6	79	176.3	31.0	39	235.4	41.4	99	294.5	51.8
60	59.1	10.4	20	118.2	20.8	80	177.3	31.2	40	236.4	41.6	300	295.4	52.0
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 80 Degrees

Difference of Latitude and Departure for 11 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	22	119.8	23.3	82	178.6	34.7	42	237.5	46.2
3	03.0	00.6	63	61.8	12.0	23	120.7	23.5	83	179.6	34.9	43	238.5	46.4
4	03.9	00.8	64	62.8	12.2	24	121.7	23.7	84	180.6	35.1	44	239.5	46.6
5	04.9	01.0	65	63.8	12.4	25	122.7	23.9	85	181.6	35.3	45	240.5	46.7
6	05.9	01.1	66	64.8	12.6	26	123.7	24.0	86	182.6	35.5	46	241.5	47.0
7	06.9	01.3	67	65.8	12.8	27	124.7	24.2	87	183.6	35.7	47	242.5	47.1
8	07.9	01.5	68	66.7	13.0	28	125.6	24.4	88	184.5	35.9	48	243.4	47.3
9	08.8	01.7	69	67.7	13.2	29	126.6	24.6	89	185.5	36.1	49	244.4	47.5
10	09.8	01.9	70	68.7	13.4	30	127.6	24.8	90	186.5	36.3	50	245.4	47.7
11	10.8	02.1	71	69.7	13.5	31	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	32	129.6	25.2	92	188.5	36.6	52	247.4	48.1
13	12.8	02.5	73	71.7	13.9	33	130.6	25.4	93	189.4	36.8	53	248.3	48.3
14	13.7	02.7	74	72.6	14.1	34	131.5	25.6	94	190.4	37.0	54	249.3	48.5
15	14.7	02.9	75	73.6	14.3	35	132.5	25.8	95	191.4	37.2	55	250.3	48.7
16	15.7	03.1	76	74.6	14.5	36	133.5	25.9	96	192.4	37.4	56	251.3	48.8
17	16.7	03.2	77	75.6	14.7	37	134.5	26.1	97	193.4	37.6	57	252.3	49.0
18	17.7	03.4	78	76.6	14.9	38	135.5	26.3	98	194.4	37.8	58	253.2	49.2
19	18.7	03.6	79	77.5	15.1	39	136.4	26.5	99	195.4	38.0	59	254.2	49.4
20	19.6	03.8	80	78.5	15.3	40	137.4	26.7	200	196.3	38.2	60	255.2	49.6
21	20.6	04.0	81	79.5	15.5	41	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	42	139.4	27.1	02	198.3	38.5	62	257.2	50.0
23	22.6	04.4	83	81.5	15.8	43	140.4	27.3	03	199.3	38.7	63	258.2	50.2
24	23.6	04.6	84	82.5	16.0	44	141.3	27.5	04	200.2	38.9	64	259.1	50.4
25	24.5	04.8	85	83.4	16.2	45	142.3	27.7	05	201.2	39.1	65	260.1	50.6
26	25.5	05.0	86	84.4	16.4	46	143.3	27.9	06	202.2	39.3	66	261.1	50.8
27	26.5	05.2	87	85.4	16.6	47	144.3	28.0	07	203.2	39.5	67	262.1	50.9
28	27.5	05.3	88	86.4	16.8	48	145.3	28.2	08	204.2	39.7	68	263.1	51.1
29	28.5	05.5	89	87.4	17.0	49	146.3	28.4	09	205.2	39.9	69	264.0	51.3
30	29.4	05.7	90	88.3	17.2	50	147.2	28.6	10	206.1	40.1	70	265.0	51.5
31	30.4	05.9	91	89.3	17.4	51	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	52	149.2	29.0	12	208.1	40.4	72	267.0	51.9
33	32.4	06.3	93	91.3	17.7	53	150.2	29.2	13	209.1	40.6	73	268.0	52.1
34	33.4	06.5	94	92.3	17.9	54	151.2	29.4	14	210.1	41.8	74	269.0	52.3
35	34.4	06.7	95	93.3	18.1	55	152.1	29.6	15	211.0	41.0	75	269.9	52.5
36	35.3	06.9	96	94.2	18.3	56	153.1	29.8	16	212.0	41.2	76	270.9	52.7
37	36.3	07.1	97	95.2	18.5	57	154.1	30.0	17	213.0	41.4	77	271.9	52.9
38	37.3	07.3	98	96.2	18.7	58	155.1	30.1	18	214.0	41.6	78	272.9	53.0
39	38.3	07.4	99	97.2	18.9	59	156.1	30.3	19	215.0	41.8	79	273.9	53.2
40	39.3	07.6	100	98.2	19.1	60	157.1	30.5	20	215.9	42.0	80	274.8	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	02	100.1	19.5	62	159.0	30.9	22	217.9	42.4	82	276.8	53.8
43	42.2	08.2	03	101.1	19.7	63	160.0	31.1	23	218.9	42.5	83	277.8	54.0
44	43.2	08.4	04	102.1	19.8	64	161.0	31.3	24	219.9	42.7	84	278.8	54.2
45	44.2	08.6	05	103.1	20.0	65	162.0	31.5	25	220.9	42.9	85	279.8	54.4
46	45.2	08.8	06	104.0	20.2	66	162.9	31.7	26	221.8	43.1	86	280.7	54.6
47	46.1	09.0	07	105.0	20.4	67	163.9	31.9	27	222.8	43.3	87	281.7	54.8
48	47.1	09.2	08	106.0	20.6	68	164.9	32.1	28	223.8	43.5	88	282.7	55.0
49	48.1	09.3	09	107.0	20.8	69	165.9	32.2	29	224.8	43.7	89	283.7	55.1
50	49.1	09.5	10	108.0	21.0	70	166.9	32.4	30	225.8	43.9	90	284.7	55.3
51	50.1	09.7	111	109.0	21.2	171	167.9	32.6	231	226.7	44.1	291	285.0	55.5
52	51.0	09.9	12	109.9	21.4	72	168.8	32.8	32	227.7	44.3	92	286.6	55.7
53	52.0	10.1	13	110.9	21.6	73	169.8	33.0	33	228.7	44.5	93	287.6	55.9
54	53.0	10.3	14	111.9	21.8	74	170.8	33.2	34	229.7	44.6	94	288.6	56.0
55	54.0	10.5	15	112.9	21.9	75	171.8	33.4	35	230.7	44.8	95	289.6	56.3
56	55.0	10.7	16	113.9	22.1	76	172.8	33.6	36	231.7	45.0	96	290.5	56.5
57	56.0	10.9	17	114.8	22.3	77	173.7	33.8	37	232.6	45.2	97	291.5	56.7
58	56.9	11.1	18	115.8	22.5	78	174.7	34.0	38	233.6	45.4	98	292.5	56.8
59	57.9	11.3	19	116.8	22.7	79	175.7	34.2	39	234.6	45.6	99	293.5	57.0
60	58.9	11.4	20	117.8	22.9	80	176.7	34.3	40	235.6	45.8	300	294.5	57.2
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

Difference of Latitude and Departure for 12 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.2	61	59.7	12.7	121	118.3	25.2	181	177.0	37.6	241	235.7	50.1
2	02.0	00.4	62	60.6	12.9	122	119.3	25.4	182	178.0	37.9	242	236.7	50.3
3	02.9	00.6	63	61.6	13.1	123	120.3	25.6	183	179.0	38.1	243	237.7	50.5
4	03.9	00.8	64	62.6	13.3	124	121.3	25.8	184	180.0	38.3	244	238.6	50.8
5	04.9	01.0	65	63.6	13.5	125	122.3	26.0	185	180.9	38.5	245	239.6	51.0
6	05.9	01.2	66	64.5	13.7	126	123.2	26.2	186	181.9	38.7	246	240.6	51.2
7	06.8	01.5	67	65.5	13.9	127	124.2	26.4	187	182.9	38.9	247	241.6	51.4
8	07.8	01.7	68	66.5	14.1	128	125.2	26.6	188	183.9	39.1	248	242.5	51.6
9	08.8	01.9	69	67.5	14.4	129	126.2	26.8	189	184.8	39.3	249	243.5	51.8
10	09.8	02.1	70	68.5	14.6	130	127.1	27.0	190	185.8	39.5	250	244.5	52.0
11	10.8	02.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	02.5	72	70.4	15.0	132	129.1	27.5	192	187.8	39.9	252	246.5	52.4
13	12.7	02.7	73	71.4	15.2	133	130.1	27.7	193	188.8	40.1	253	247.4	52.6
14	13.7	02.9	74	72.4	15.4	134	131.1	27.9	194	189.7	40.4	254	248.4	52.8
15	14.7	03.1	75	73.4	15.6	135	132.0	28.1	195	190.7	40.6	255	249.4	53.0
16	15.6	03.3	76	74.3	15.8	136	133.0	28.3	196	191.7	40.8	256	250.4	53.2
17	16.6	03.5	77	75.3	16.0	137	134.0	28.5	197	192.7	41.0	257	251.3	53.5
18	17.6	03.7	78	76.3	16.2	138	135.0	28.7	198	193.6	41.2	258	252.3	53.7
19	18.6	04.0	79	77.3	16.4	139	135.9	28.9	199	194.6	41.4	259	253.3	53.9
20	19.6	04.2	80	78.2	16.6	140	136.9	29.1	200	195.6	41.6	260	254.3	54.1
21	20.5	04.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	04.6	82	80.2	17.1	142	138.9	29.5	202	197.6	42.0	262	256.2	54.5
23	22.5	04.8	83	81.2	17.3	143	139.9	29.7	203	198.5	42.2	263	257.2	54.7
24	23.5	05.0	84	82.2	17.5	144	140.8	30.0	204	199.5	42.4	264	258.2	54.9
25	24.5	05.2	85	83.1	17.7	145	141.8	30.2	205	200.5	42.6	265	259.2	55.1
26	25.4	05.4	86	84.1	17.9	146	142.8	30.4	206	201.5	42.8	266	260.1	55.3
27	26.4	05.6	87	85.1	18.0	147	143.8	30.6	207	202.4	43.1	267	261.1	55.5
28	27.4	05.8	88	86.1	18.3	148	144.7	30.8	208	203.4	43.3	268	262.1	55.7
29	28.4	06.0	89	87.0	18.5	149	145.7	31.0	209	204.4	43.5	269	263.1	56.0
30	29.3	06.2	90	88.0	18.7	150	146.7	31.2	210	205.4	43.7	270	264.1	56.2
31	30.3	06.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.0	56.4
32	31.3	06.7	92	90.0	19.1	152	148.7	31.6	212	207.3	44.1	272	266.0	56.6
33	32.3	06.9	93	91.0	19.3	153	149.6	31.8	213	208.3	44.3	273	267.0	56.8
34	33.3	07.1	94	91.9	19.6	154	150.6	32.0	214	209.3	44.5	274	268.0	57.0
35	34.2	07.3	95	92.9	19.8	155	151.6	32.2	215	210.3	44.7	275	269.0	57.2
36	35.2	07.5	96	93.9	20.0	156	152.6	32.4	216	211.2	44.9	276	269.9	57.4
37	36.2	07.7	97	94.9	20.2	157	153.5	32.7	217	212.2	45.1	277	270.9	57.6
38	37.2	07.9	98	95.8	20.4	158	154.5	32.9	218	213.2	45.3	278	271.9	57.8
39	38.1	08.1	99	96.8	20.6	159	155.5	33.1	219	214.2	45.6	279	272.9	58.0
40	39.1	08.3	100	97.8	20.8	160	156.5	33.3	220	215.2	45.8	280	273.8	58.2
41	40.1	08.5	101	98.8	21.0	161	157.5	33.5	221	216.1	46.0	281	274.8	58.4
42	41.1	08.7	102	99.8	21.2	162	158.4	33.7	222	217.1	46.2	282	275.8	58.7
43	42.1	08.9	103	100.7	21.4	163	159.4	33.9	223	218.1	46.4	283	276.8	58.9
44	43.0	09.2	104	101.7	21.6	164	160.4	34.1	224	219.1	46.6	284	277.8	59.1
45	44.0	09.4	105	102.7	21.8	165	161.4	34.3	225	220.1	46.8	285	278.7	59.3
46	45.0	09.6	106	103.7	22.0	166	162.3	34.5	226	221.0	47.0	286	279.7	59.5
47	46.0	09.8	107	104.6	22.3	167	163.3	34.7	227	222.0	47.2	287	280.7	59.7
48	46.9	10.0	108	105.6	22.5	168	164.3	34.9	228	223.0	47.4	288	281.7	59.9
49	47.9	10.2	109	106.6	22.7	169	165.3	35.2	229	224.0	47.6	289	282.6	60.1
50	48.9	10.4	110	107.6	22.9	170	166.3	35.4	230	224.9	47.8	290	283.6	60.3
51	49.9	10.6	111	108.6	23.1	171	167.2	35.6	231	225.9	48.0	291	284.6	60.5
52	50.9	10.8	112	109.5	23.3	172	168.2	35.8	232	226.9	48.3	292	285.6	60.7
53	51.8	11.0	113	110.5	23.5	173	169.2	36.0	233	227.9	48.5	293	286.6	60.9
54	52.8	11.2	114	111.5	23.7	174	170.2	36.2	234	228.9	48.7	294	287.5	61.2
55	53.8	11.4	115	112.5	23.9	175	171.2	36.4	235	229.8	48.9	295	288.5	61.4
56	54.8	11.6	116	113.4	24.1	176	172.1	36.6	236	230.8	49.1	296	289.5	61.6
57	55.7	11.9	117	114.4	24.3	177	173.1	36.8	237	231.8	49.3	297	290.5	61.8
58	56.7	12.1	118	115.4	24.5	178	174.1	37.0	238	232.8	49.5	298	291.4	62.0
59	57.7	12.3	119	116.4	24.8	179	175.1	37.2	239	233.7	49.7	299	292.4	62.2
60	58.7	12.5	120	117.4	25.0	180	176.0	37.4	240	234.7	49.9	300	293.4	62.4
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 78 Degrees

Difference of Latitude and Departure for 13 Degrees

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	22	118.9	27.4	82	177.3	40.9	42	235.8	54.4
3	02.9	00.7	63	61.4	14.2	23	119.8	27.7	83	178.3	41.2	43	236.8	55.7
4	03.9	00.9	64	62.4	14.4	24	120.8	27.9	84	179.3	41.4	44	237.8	55.9
5	04.9	01.1	65	63.3	14.6	25	121.8	28.1	85	180.3	41.6	45	238.7	55.1
6	05.8	01.3	66	64.3	14.8	26	122.8	28.3	86	181.2	41.8	46	239.7	55.3
7	06.8	01.6	67	65.3	15.1	27	123.7	28.6	87	182.2	42.1	47	240.7	55.6
8	07.8	01.8	68	66.3	15.3	28	124.7	28.8	88	183.2	42.3	48	241.6	55.8
9	08.8	02.0	69	67.2	15.5	29	125.7	29.0	89	184.2	42.5	49	242.6	56.0
10	09.7	02.2	70	68.2	15.7	30	126.7	29.2	90	185.1	42.7	50	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	32	128.6	29.7	92	187.1	43.2	52	245.5	56.7
13	12.7	02.9	73	71.1	16.4	33	129.6	29.9	93	188.1	43.4	53	246.5	56.9
14	13.6	03.1	74	72.1	16.6	34	130.6	30.1	94	189.0	43.6	54	247.5	57.1
15	14.6	03.4	75	73.1	16.9	35	131.5	30.4	95	190.0	43.9	55	248.5	57.4
16	15.6	03.6	76	74.1	17.1	36	132.5	30.6	96	191.0	44.1	56	249.4	57.6
17	16.6	03.8	77	75.0	17.3	37	133.5	30.8	97	192.0	44.3	57	250.4	57.8
18	17.5	04.0	78	76.0	17.5	38	134.5	31.0	98	192.9	44.5	58	251.4	58.0
19	18.5	04.3	79	77.0	17.8	39	135.4	31.3	99	193.9	44.8	59	252.4	58.3
20	19.5	04.5	80	78.0	18.0	40	136.4	31.5	200	194.9	45.0	60	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.9	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	42	138.4	31.9	02	196.8	45.4	62	255.3	58.9
23	22.4	05.2	83	80.9	18.7	43	139.3	32.2	03	197.8	45.7	63	256.3	59.2
24	23.4	05.4	84	81.8	18.9	44	140.3	32.4	04	198.8	45.9	64	257.2	59.4
25	24.4	05.6	85	82.8	19.1	45	141.3	32.6	05	199.7	46.1	65	258.2	59.6
26	25.3	05.8	86	83.8	19.3	46	142.3	32.8	06	200.7	46.3	66	259.2	59.8
27	26.3	06.1	87	84.8	19.6	47	143.2	33.1	07	201.7	46.6	67	260.2	60.1
28	27.3	06.3	88	85.7	19.8	48	144.2	33.3	08	202.7	46.8	68	261.1	60.3
29	28.3	06.5	89	86.7	20.0	49	145.2	33.5	09	203.6	47.0	69	262.1	60.5
30	29.2	06.7	90	87.7	20.2	50	146.2	33.7	10	204.6	47.2	70	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	52	148.1	34.2	12	206.6	47.7	72	265.0	61.2
33	32.2	07.4	93	90.6	20.9	53	149.1	34.4	13	207.5	47.9	73	266.0	61.4
34	33.1	07.6	94	91.6	21.1	54	150.1	34.6	14	208.5	48.1	74	267.0	61.6
35	34.1	07.9	95	92.6	21.4	55	151.0	34.9	15	209.5	48.4	75	268.0	61.9
36	35.1	08.1	96	93.5	21.6	56	152.0	35.1	16	210.5	48.6	76	268.9	62.1
37	36.1	08.3	97	94.5	21.8	57	153.0	35.3	17	211.4	48.8	77	269.9	62.3
38	37.0	08.5	98	95.5	22.0	58	154.0	35.5	18	212.4	49.0	78	270.9	62.5
39	38.0	08.8	99	96.5	22.3	59	154.9	35.8	19	213.4	49.3	79	271.9	62.8
40	39.0	08.0	100	97.4	22.5	60	155.9	36.0	20	214.4	49.5	80	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	02	99.4	22.9	62	157.9	36.4	22	216.3	49.9	82	274.8	63.4
43	41.9	09.7	03	100.4	23.2	63	158.8	36.7	23	217.3	50.2	83	275.8	63.7
44	42.9	09.9	04	101.3	23.4	64	159.8	36.9	24	218.3	50.4	84	276.7	63.9
45	43.8	10.1	05	102.3	23.6	65	160.8	37.1	25	219.2	50.6	85	277.7	64.1
46	44.8	10.3	06	103.3	23.8	66	161.7	37.3	26	220.2	50.8	86	278.7	64.3
47	45.8	10.6	07	104.3	24.1	67	162.7	37.6	27	221.2	51.1	87	279.6	64.6
48	46.8	10.8	08	105.2	24.3	68	163.7	37.8	28	222.2	51.3	88	280.6	64.8
49	47.7	11.0	09	106.2	24.5	69	164.7	38.0	29	223.1	51.5	89	281.6	65.0
50	48.7	11.2	10	107.2	24.7	70	165.6	38.2	30	224.1	51.7	90	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	12	109.1	25.2	72	167.6	38.7	32	226.1	52.2	92	284.5	65.7
53	51.6	11.9	13	110.1	25.4	73	168.6	38.9	33	227.0	52.4	93	285.5	65.9
54	52.6	12.1	14	111.1	25.6	74	169.5	39.1	34	228.0	52.6	94	286.5	66.1
55	53.6	12.4	15	112.1	25.9	75	170.5	39.4	35	229.0	52.9	95	287.4	66.4
56	54.6	12.6	16	113.0	26.1	76	171.5	39.6	36	230.0	53.1	96	288.4	66.6
57	55.5	12.8	17	114.0	26.3	77	172.5	39.8	37	230.9	53.3	97	289.4	66.8
58	56.5	13.0	18	115.0	26.5	78	173.4	40.0	38	231.9	53.5	98	290.4	67.0
59	57.5	13.3	19	116.0	26.8	79	174.4	40.3	39	232.9	53.8	99	291.3	67.3
60	58.5	13.5	20	116.9	27.0	80	175.4	40.5	40	233.9	54.0	300	292.3	67.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 77 Degrees.

Difference of Latitude and Departure for 14 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	01.9	00.5	62	60.2	15.0	122	118.4	29.5	82	176.6	44.0	42	234.8	58.6
3	02.9	00.7	63	61.1	15.2	23	119.3	29.8	83	177.6	44.3	43	235.8	58.8
4	03.9	01.0	64	62.1	15.5	24	120.3	30.0	84	178.5	44.5	44	236.7	59.0
5	04.9	01.2	65	63.1	15.7	25	121.3	30.2	85	179.5	44.8	45	237.7	59.3
6	05.8	01.5	66	64.0	16.0	26	122.3	30.5	86	180.5	45.0	46	238.7	59.5
7	06.8	01.7	67	65.0	16.2	27	123.2	30.7	87	181.4	45.3	47	239.7	59.8
8	07.8	01.9	68	66.0	16.5	28	124.2	31.0	88	182.4	45.5	48	240.6	60.0
9	08.7	02.2	69	66.9	16.7	29	125.2	31.2	89	183.4	45.7	49	241.6	60.3
10	09.7	02.4	70	67.9	16.9	30	126.1	31.5	90	184.4	46.0	50	242.6	60.5
11	10.7	02.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	02.9	72	69.9	17.4	32	128.1	31.9	92	186.3	46.5	52	244.5	61.0
13	12.6	03.1	73	70.8	17.7	33	129.0	32.2	93	187.3	46.7	53	245.5	61.2
14	13.6	03.4	74	71.8	17.9	34	130.0	32.4	94	188.2	46.9	54	246.4	61.5
15	14.6	03.6	75	72.8	18.1	35	131.0	32.7	95	189.2	47.2	55	247.4	61.7
16	15.5	03.9	76	73.7	18.4	36	132.0	32.9	96	190.2	47.4	56	248.4	62.0
17	16.5	04.1	77	74.7	18.6	37	132.9	33.2	97	191.1	47.7	57	249.4	62.2
18	17.5	04.4	78	75.7	18.9	38	133.9	33.4	98	192.1	47.9	58	250.3	62.4
19	18.4	04.6	79	76.7	19.1	39	134.9	33.6	99	193.1	48.2	59	251.3	62.7
20	19.4	04.8	80	77.6	19.4	40	135.9	33.9	200	194.1	48.4	60	252.3	62.9
21	20.4	05.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.2
22	21.3	05.3	82	79.6	19.8	42	137.8	34.4	02	196.0	48.9	62	254.2	63.4
23	22.3	05.6	83	80.5	20.1	43	138.7	34.6	03	197.0	49.1	63	255.2	63.6
24	23.3	05.8	84	81.5	20.3	44	139.7	34.8	04	197.9	49.4	64	256.2	63.9
25	24.3	06.0	85	82.5	20.6	45	140.7	35.1	05	198.9	49.6	65	257.1	64.1
26	25.2	06.3	86	83.4	20.8	46	141.7	35.3	06	199.9	49.9	66	258.1	64.4
27	26.2	06.5	87	84.4	21.1	47	142.6	35.6	07	200.8	50.1	67	259.1	64.6
28	27.2	06.8	88	85.4	21.3	48	143.6	35.8	08	201.8	50.3	68	260.0	64.9
29	28.1	07.0	89	86.4	21.5	49	144.6	36.1	09	202.8	50.6	69	261.0	65.1
30	29.1	07.2	90	87.3	21.8	50	145.5	36.3	10	203.8	50.8	70	262.0	65.3
31	30.1	07.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.1	271	262.9	65.6
32	31.0	07.7	92	89.3	22.3	52	147.5	36.8	12	205.7	51.3	72	263.9	65.8
33	32.0	08.0	93	90.2	22.5	53	148.5	37.0	13	206.7	51.5	73	264.9	66.1
34	33.0	08.2	94	91.2	22.7	54	149.4	37.3	14	207.6	51.8	74	265.9	66.3
35	34.0	08.5	95	92.2	23.0	55	150.4	37.5	15	208.6	52.0	75	266.8	66.5
36	34.9	08.7	96	93.1	23.2	56	151.4	37.7	16	209.6	52.3	76	267.8	66.8
37	35.9	09.0	97	94.1	23.5	57	152.3	38.0	17	210.5	52.5	77	268.8	67.0
38	36.9	09.2	98	95.1	23.7	58	153.3	38.2	18	211.5	52.8	78	269.7	67.3
39	37.8	09.4	99	96.1	24.0	59	154.3	38.5	19	212.5	53.0	79	270.7	67.5
40	38.8	09.7	100	97.0	24.2	60	155.2	38.7	20	213.5	53.2	80	271.7	67.8
41	39.8	09.9	101	98.0	24.4	161	156.2	39.0	221	214.4	53.5	281	272.6	68.0
42	40.8	10.2	02	99.0	24.7	62	157.2	39.2	22	215.4	53.7	82	273.6	68.2
43	41.7	10.4	03	99.9	24.9	63	158.2	39.4	23	216.4	54.0	83	274.6	68.5
44	42.7	10.6	04	100.9	25.2	64	159.1	39.7	24	217.3	54.2	84	275.6	68.7
45	43.7	10.9	05	101.9	25.4	65	160.1	39.9	25	218.3	54.4	85	276.5	69.0
46	44.6	11.1	06	102.8	25.7	66	161.1	40.2	26	219.3	54.7	86	277.5	69.2
47	45.6	11.4	07	103.8	25.9	67	162.0	40.4	27	220.3	54.9	87	278.5	69.5
48	46.6	11.6	08	104.8	26.1	68	163.0	40.7	28	221.2	55.2	88	279.4	69.7
49	47.5	11.9	09	105.8	26.4	69	164.0	40.9	29	222.2	55.4	89	280.4	69.9
50	48.5	12.1	10	106.7	26.6	70	164.9	41.1	30	223.2	55.7	90	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.3	70.4
52	50.5	12.6	12	108.7	27.1	72	166.9	41.6	32	225.1	56.1	92	283.3	70.7
53	51.4	12.8	13	109.6	27.3	73	167.9	41.9	33	226.1	56.4	93	284.3	70.9
54	52.4	13.1	14	110.6	27.6	74	168.8	42.1	34	227.0	56.6	94	285.3	71.1
55	53.4	13.3	15	111.6	27.8	75	169.8	42.3	35	228.0	56.9	95	286.2	71.4
56	54.3	13.6	16	112.6	28.1	76	170.8	42.7	36	229.0	57.1	96	287.2	71.6
57	55.3	13.8	17	113.5	28.3	77	171.7	42.8	37	230.0	57.4	97	288.2	71.9
58	56.3	14.0	18	114.5	28.6	78	172.7	43.1	38	230.9	57.6	98	289.1	72.1
59	57.2	14.3	19	115.5	28.8	79	173.7	43.3	39	231.9	57.8	99	290.1	72.4
60	58.2	14.5	20	116.4	29.0	80	174.6	43.6	40	232.9	58.1	300	291.1	72.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 76 Degrees.

Difference of Latitude and Departure for 15 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	122	117.8	31.6	182	175.8	47.1	242	233.7	62.6
3	02.9	00.8	63	60.9	16.3	123	118.8	31.8	183	176.8	47.4	243	234.7	62.9
4	03.9	01.0	64	61.8	16.6	124	119.8	32.1	184	177.7	47.6	244	235.7	63.1
5	04.8	01.3	65	62.8	16.8	125	120.7	32.4	185	178.7	47.9	245	236.6	63.4
6	05.8	01.6	66	63.7	17.1	126	121.7	32.6	186	179.7	48.1	246	237.6	63.7
7	06.8	01.8	67	64.7	17.3	127	122.7	32.9	187	180.6	48.4	247	238.6	63.9
8	07.7	02.1	68	65.7	17.6	128	123.6	33.1	188	181.6	48.7	248	239.5	64.2
9	08.7	02.3	69	66.6	17.9	129	124.6	33.4	189	182.6	48.9	249	240.5	64.4
10	09.7	02.6	70	67.6	18.1	130	125.6	33.6	190	183.5	49.2	250	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	132	127.5	34.2	192	185.5	49.7	252	243.4	65.2
13	12.6	03.4	73	70.5	18.9	133	128.5	34.4	193	186.4	49.9	253	244.4	65.5
14	13.5	03.6	74	71.5	19.2	134	129.4	34.7	194	187.4	50.2	254	245.3	65.7
15	14.5	03.9	75	72.4	19.4	135	130.4	34.9	195	188.4	50.5	255	246.3	66.0
16	15.5	04.1	76	73.4	19.7	136	131.4	35.2	196	189.3	50.7	256	247.3	66.3
17	16.4	04.4	77	74.4	19.9	137	132.3	35.5	197	190.3	51.0	257	248.2	66.5
18	17.4	04.7	78	75.3	20.2	138	133.3	35.7	198	191.2	51.2	258	249.2	66.8
19	18.4	04.9	79	76.3	20.4	139	134.3	36.0	199	192.2	51.5	259	250.2	67.0
20	19.3	05.2	80	77.3	20.7	140	135.2	36.2	200	193.2	51.8	260	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.1	52.0	261	252.1	67.5
22	21.2	05.7	82	79.2	21.2	142	137.2	36.7	202	195.1	52.3	262	253.1	67.8
23	22.2	06.0	83	80.2	21.5	143	138.1	37.0	203	196.1	52.5	263	254.0	68.1
24	23.2	06.2	84	81.1	21.7	144	139.1	37.3	204	197.0	52.8	264	255.0	68.3
25	24.1	06.5	85	82.1	22.0	145	140.1	37.5	205	198.0	53.1	265	256.0	68.6
26	25.1	06.7	86	83.1	22.3	146	141.0	37.8	206	199.0	53.3	266	256.9	68.8
27	26.1	07.0	87	84.0	22.5	147	142.0	38.0	207	199.9	53.6	267	257.9	69.1
28	27.0	07.2	88	85.0	22.8	148	143.0	38.3	208	200.9	53.8	268	258.9	69.4
29	28.0	07.5	89	86.0	23.0	149	143.0	38.6	209	201.9	54.1	269	259.8	69.6
30	29.0	07.8	90	86.9	23.3	150	144.9	38.8	210	202.8	54.3	270	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.8	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	152	146.8	39.3	212	204.8	54.9	272	262.7	70.4
33	31.9	08.5	93	89.8	24.1	153	147.8	39.6	213	205.7	55.1	273	263.7	70.7
34	32.8	08.8	94	90.8	24.3	154	148.7	39.9	214	206.7	55.4	274	264.7	70.9
35	33.8	09.1	95	91.8	24.6	155	149.7	40.1	215	207.7	55.6	275	265.6	71.2
36	34.8	09.3	96	92.7	24.8	156	150.7	40.4	216	208.7	55.9	276	266.6	71.4
37	35.7	09.6	97	93.7	25.1	157	151.6	40.6	217	209.6	56.1	277	267.6	71.7
38	36.7	09.8	98	94.7	25.4	158	152.6	40.9	218	210.6	56.4	278	268.5	71.9
39	37.7	10.1	99	95.6	25.6	159	153.6	41.1	219	211.5	56.7	279	269.5	72.2
40	38.6	10.4	100	96.6	25.9	160	154.5	41.4	220	212.5	56.9	280	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	102	98.5	26.4	162	156.5	41.9	222	214.4	57.5	282	272.4	73.0
43	41.5	11.1	103	99.5	26.7	163	157.4	42.2	223	215.4	57.7	283	273.4	73.2
44	42.5	11.4	104	100.5	26.9	164	158.4	42.4	224	216.4	58.0	284	274.3	73.5
45	43.5	11.6	105	101.4	27.2	165	159.4	42.7	225	217.3	58.2	285	275.3	73.8
46	44.4	11.9	106	102.4	27.4	166	160.3	43.0	226	218.3	58.5	286	276.2	74.0
47	45.4	12.2	107	103.4	27.7	167	161.3	43.2	227	219.3	58.7	287	277.2	74.3
48	46.4	12.4	108	104.3	28.0	168	162.3	43.5	228	220.2	59.0	288	278.2	74.5
49	47.3	12.7	109	105.3	28.2	169	163.2	43.7	229	221.2	59.3	289	279.1	74.8
50	48.3	12.9	110	106.2	28.5	170	164.2	44.0	230	222.2	59.5	290	280.1	75.0
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	112	108.2	29.0	172	166.1	44.5	232	224.1	60.0	292	282.0	75.6
53	51.2	13.7	113	109.1	29.2	173	167.1	44.8	233	225.1	60.3	293	283.0	75.8
54	52.2	14.0	114	110.1	29.5	174	168.1	45.0	234	226.0	60.6	294	284.0	76.1
55	53.1	14.2	115	111.1	29.8	175	169.0	45.3	235	227.0	60.8	295	284.9	76.3
56	54.1	14.5	116	112.0	30.0	176	170.0	45.5	236	228.0	61.1	296	285.9	76.6
57	55.1	14.8	117	113.0	30.3	177	171.0	45.8	237	228.9	61.3	297	286.9	76.9
58	56.0	15.0	118	114.0	30.5	178	171.9	46.1	238	229.9	61.6	298	287.8	77.1
59	57.0	15.3	119	114.9	30.8	179	172.9	46.3	239	230.9	61.9	299	288.8	77.4
60	58.0	15.5	120	115.9	30.1	180	173.9	46.6	240	231.8	62.1	300	289.8	77.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 75 Degrees.

Difference of Latitude and Departure for 16 Degrees.

Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.	Diff.	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.3	181	174.0	49.9	241	231.6	66.4
2	01.9	00.6	62	59.6	17.1	22	117.3	33.6	82	174.9	50.2	42	232.6	66.7
3	02.9	00.8	63	60.6	17.4	23	118.2	33.9	83	175.9	50.4	43	233.6	67.0
4	03.8	01.1	64	61.5	17.6	24	119.2	34.2	84	176.8	50.7	44	234.5	67.2
5	04.8	01.4	65	62.5	17.9	25	120.1	34.4	85	177.8	51.0	45	235.5	67.5
6	05.8	01.7	66	63.4	18.2	26	121.1	34.7	86	178.8	51.3	46	236.4	67.8
7	06.7	01.9	67	64.4	18.5	27	122.1	35.0	87	179.7	51.5	47	237.4	68.1
8	07.7	02.2	68	65.4	18.7	28	123.0	35.3	88	180.7	51.8	48	238.4	68.3
9	08.7	02.5	69	66.3	19.0	29	124.0	35.6	89	181.7	52.1	49	239.3	68.6
10	09.6	02.8	70	67.3	19.3	30	124.9	35.8	90	182.6	52.4	50	240.3	68.9
11	10.6	03.0	71	68.2	19.6	31	125.9	36.1	91	183.6	52.6	51	241.2	69.2
12	11.5	03.3	72	69.2	19.8	32	126.9	36.4	92	184.5	52.9	52	242.2	69.5
13	12.4	03.6	73	70.2	20.1	33	127.8	36.7	93	185.5	53.2	53	243.2	69.7
14	13.5	03.9	74	71.1	20.4	34	128.8	36.9	94	186.5	53.5	54	244.1	70.0
15	14.4	04.1	75	72.1	20.7	35	129.8	37.2	95	187.4	53.7	55	245.1	70.3
16	15.4	04.4	76	73.0	20.9	36	130.7	37.5	96	188.4	54.0	56	246.0	70.6
17	16.3	04.7	77	74.0	21.2	37	131.7	37.8	97	189.3	54.3	57	247.0	70.8
18	17.3	05.0	78	75.0	21.5	38	132.6	38.0	98	190.3	54.6	58	248.0	71.1
19	18.3	05.2	79	75.9	21.8	39	133.6	38.3	99	191.3	54.8	59	248.9	71.4
20	19.2	05.5	80	76.9	22.0	40	134.6	38.6	200	192.2	55.1	60	249.9	71.7
21	20.2	05.8	81	77.9	22.3	41	135.5	38.9	201	193.2	55.4	61	250.9	71.9
22	21.1	06.1	82	78.8	22.6	42	136.5	39.1	92	194.1	55.7	62	251.8	72.2
23	22.1	06.3	83	79.8	22.9	43	137.4	39.4	93	195.1	55.9	63	252.8	72.5
24	23.1	06.6	84	80.7	23.1	44	138.4	39.7	94	196.1	56.2	64	253.7	72.8
25	24.0	06.9	85	81.7	23.4	45	139.4	40.0	95	197.0	56.5	65	254.7	73.0
26	25.0	07.2	86	82.7	23.7	46	140.3	40.2	96	198.0	56.8	66	255.7	73.3
27	26.0	07.4	87	83.6	24.0	47	141.3	40.5	97	199.0	57.0	67	256.6	73.6
28	26.9	07.7	88	84.6	24.1	48	142.2	40.8	98	199.9	57.3	68	257.6	73.9
29	27.9	08.0	89	85.5	24.5	49	143.2	41.1	99	200.9	57.6	69	258.5	74.1
30	28.8	08.3	90	86.5	24.8	50	144.2	41.3	100	201.8	57.9	70	259.5	74.4
31	29.8	08.5	91	87.5	25.1	51	145.1	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	52	146.1	41.9	12	203.8	58.4	72	261.4	75.0
33	31.7	09.1	93	89.4	25.6	53	147.1	42.2	13	204.7	58.7	73	262.4	75.2
34	32.7	09.4	94	90.3	25.9	54	148.0	42.4	14	205.7	59.0	74	263.3	75.5
35	33.6	09.6	95	91.3	26.2	55	149.0	42.7	15	206.6	59.3	75	264.3	75.8
36	34.6	09.9	96	92.3	26.5	56	149.9	43.0	16	207.6	59.5	76	265.3	76.1
37	35.6	10.2	97	93.2	26.7	57	150.9	43.3	17	208.6	59.8	77	266.2	76.3
38	36.5	10.5	98	94.2	27.0	58	151.9	43.5	18	209.5	60.1	78	267.2	76.6
39	37.5	10.7	99	95.2	27.3	59	152.8	43.8	19	210.5	60.4	79	268.2	76.9
40	38.4	11.0	100	96.1	27.6	60	153.8	44.1	20	211.4	60.6	80	269.1	77.2
41	39.4	11.3	101	97.1	27.8	61	154.7	44.4	221	212.4	60.9	281	270.1	77.4
42	40.4	11.6	102	98.0	28.1	62	155.7	44.6	22	213.4	61.2	82	271.0	77.7
43	41.3	11.9	103	99.0	28.4	63	156.7	44.9	23	214.3	61.5	83	272.0	78.0
44	42.3	12.1	104	100.0	28.7	64	157.6	45.2	24	215.3	61.7	84	273.0	78.3
45	43.3	12.4	105	100.9	28.9	65	158.6	45.5	25	216.3	62.0	85	273.9	78.5
46	44.2	12.7	106	101.9	29.2	66	159.5	45.7	26	217.2	62.3	86	274.9	78.8
47	45.2	13.0	107	102.8	29.5	67	160.5	46.0	27	218.2	62.6	87	275.8	79.1
48	46.1	13.2	108	103.8	29.8	68	161.5	46.3	28	219.1	62.8	88	276.8	79.4
49	47.1	13.5	109	104.8	30.0	69	162.4	46.6	29	220.1	63.1	89	277.8	79.6
50	48.1	13.8	110	105.7	30.3	70	163.4	46.9	30	221.1	63.4	90	278.7	79.9
51	49.0	14.1	111	106.7	30.6	71	164.4	47.1	231	222.0	63.7	291	279.7	80.2
52	50.0	14.3	112	107.6	30.9	72	165.3	47.4	32	223.0	63.9	92	280.6	80.5
53	50.9	14.6	113	108.6	31.1	73	166.3	47.7	33	223.9	64.2	93	281.6	80.8
54	51.9	14.9	114	109.6	31.4	74	167.2	48.0	34	224.9	64.5	94	282.6	81.0
55	52.9	15.2	115	110.5	31.7	75	168.2	48.2	35	225.9	64.8	95	283.5	81.3
56	53.8	15.4	116	111.5	32.0	76	169.2	48.5	36	226.8	65.0	96	284.5	81.6
57	54.8	15.7	117	112.5	32.5	77	170.1	48.8	37	227.8	65.3	97	285.5	81.9
58	55.7	16.0	118	113.4	32.7	78	171.1	49.1	38	228.7	65.6	98	286.4	82.1
59	56.7	16.3	119	114.4	32.8	79	172.0	49.3	39	229.7	65.9	99	287.4	82.4
60	57.2	16.5	120	115.3	33.1	80	173.0	49.6	40	230.7	66.1	300	288.3	82.7

for 74 Degrees.

Difference of Latitude and Departure for 17 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.4
2	01.9	00.6	62	59.3	18.1	22	116.7	35.7	82	174.0	53.2	42	231.4	70.7
3	02.9	00.9	63	60.2	18.4	23	117.6	36.0	83	175.0	53.5	43	232.4	71.0
4	03.8	01.2	64	61.2	18.7	24	118.6	36.2	84	175.9	53.8	44	233.3	71.3
5	04.8	01.5	65	62.2	19.0	25	119.5	36.5	85	176.9	54.1	45	234.3	71.6
6	05.7	01.8	66	63.1	19.3	26	120.5	36.8	86	177.9	54.4	46	235.2	71.9
7	06.7	02.0	67	64.1	19.6	27	121.4	37.1	87	178.8	54.7	47	236.2	72.1
8	07.6	02.3	68	65.0	19.9	28	122.4	37.4	88	179.8	55.0	48	237.1	72.4
9	08.5	02.6	69	66.0	20.2	29	123.4	37.7	89	180.7	55.2	49	238.1	72.7
10	09.6	02.9	70	66.9	20.5	30	124.3	38.0	90	181.7	55.5	50	239.1	73.0
11	10.5	03.2	71	67.9	20.8	31	125.3	38.3	91	182.6	55.8	51	240.0	73.3
12	11.5	03.5	72	68.8	21.0	32	126.2	38.6	92	183.6	56.1	52	241.0	73.6
13	12.4	03.8	73	69.8	21.3	33	127.2	38.9	93	184.6	56.4	53	241.9	73.9
14	13.4	04.1	74	70.8	21.6	34	128.1	39.2	94	185.5	56.7	54	242.9	74.1
15	14.3	04.4	75	71.7	21.9	35	129.1	39.5	95	186.5	57.0	55	243.8	74.4
16	15.3	04.7	76	72.7	22.2	36	130.0	39.8	96	187.4	57.3	56	244.8	74.7
17	16.3	05.0	77	73.6	22.5	37	131.0	40.0	97	188.4	57.6	57	245.8	75.0
18	17.2	05.3	78	74.6	22.8	38	132.0	40.3	98	189.3	57.9	58	246.7	75.3
19	18.2	05.6	79	75.5	23.1	39	132.9	40.6	99	190.3	58.2	59	247.7	75.6
20	19.1	05.8	80	76.5	23.4	40	133.9	40.9	200	191.2	58.5	60	248.6	75.9
21	20.1	06.1	81	77.5	23.7	41	134.8	41.2	201	192.2	58.8	61	249.6	76.2
22	21.0	06.4	82	78.4	24.0	42	135.8	41.5	02	193.2	59.0	62	250.5	76.5
23	22.0	06.7	83	79.4	24.3	43	136.7	41.8	03	194.1	59.3	63	251.5	76.8
24	22.9	07.0	84	80.3	24.6	44	137.7	42.1	04	195.1	59.6	64	252.4	77.1
25	23.9	07.3	85	81.3	24.8	45	138.7	42.4	05	196.0	59.9	65	253.4	77.4
26	24.9	07.6	86	82.2	25.1	46	139.6	42.7	06	197.0	60.2	66	254.4	77.7
27	25.8	07.9	87	83.2	25.4	47	140.6	43.0	07	197.9	60.5	67	255.3	77.9
28	26.8	08.2	88	84.1	25.7	48	141.5	43.3	08	198.9	60.8	68	256.3	78.2
29	27.7	08.5	89	85.1	26.0	49	142.5	43.6	09	199.8	61.1	69	257.2	78.5
30	28.7	08.8	90	86.1	26.3	50	143.4	43.8	10	200.8	61.4	70	258.2	78.8
31	29.6	09.1	91	87.0	26.6	51	144.4	44.1	211	201.8	61.7	71	259.1	79.1
32	30.6	09.4	92	88.0	26.9	52	145.3	44.4	12	202.7	62.0	72	260.1	79.4
33	31.6	09.6	93	88.9	27.2	53	146.3	44.7	13	203.7	62.3	73	261.1	79.7
34	32.5	09.9	94	89.9	27.5	54	147.3	45.0	14	204.6	62.6	74	262.0	80.0
35	33.5	10.2	95	90.8	27.8	55	148.2	45.3	15	205.6	62.8	75	263.0	80.3
36	34.4	10.5	96	91.8	28.1	56	149.2	45.6	16	206.5	63.1	76	263.9	80.6
37	35.4	10.8	97	92.8	28.4	57	150.1	45.9	17	207.5	63.4	77	264.9	80.9
38	36.3	11.1	98	93.7	28.6	58	151.1	46.2	18	208.5	63.7	78	265.8	81.2
39	37.3	11.4	99	94.7	28.9	59	152.0	46.5	19	209.5	64.0	79	266.8	81.5
40	38.2	11.7	100	95.6	29.2	60	153.0	46.8	20	210.4	64.3	80	267.7	81.7
41	39.2	12.0	101	96.6	29.5	61	154.0	47.1	211	211.3	64.6	281	268.7	82.0
42	40.2	12.3	02	97.5	29.8	62	154.9	47.4	22	212.3	64.9	82	269.7	82.3
43	41.1	12.6	03	98.5	30.1	63	155.9	47.6	23	213.2	65.2	83	270.6	82.6
44	42.1	12.9	04	99.4	30.4	64	156.8	47.9	24	214.2	65.5	84	271.6	82.9
45	43.0	13.2	05	100.4	30.7	65	157.8	48.2	25	215.2	65.8	85	272.5	83.2
46	44.0	13.4	06	101.4	31.0	66	158.7	48.5	26	216.1	66.1	86	273.5	83.5
47	44.9	13.7	07	102.3	31.3	67	159.7	48.8	27	217.1	66.4	87	274.4	83.8
48	45.9	14.0	08	103.3	31.6	68	160.6	49.1	28	218.0	66.6	88	275.4	84.1
49	46.9	14.3	09	104.2	31.9	69	161.6	49.4	29	219.0	66.9	89	276.4	84.4
50	47.8	14.6	10	105.2	32.2	70	162.6	49.7	30	219.9	67.2	90	277.3	84.7
51	48.8	14.9	111	106.1	32.4	71	163.5	50.0	231	220.9	67.5	291	278.3	85.0
52	49.7	15.2	12	107.1	32.7	72	164.5	50.3	32	221.8	67.8	92	279.2	85.3
53	50.7	15.5	13	108.1	33.0	73	165.4	50.6	33	222.8	68.1	93	280.2	85.6
54	51.6	15.8	14	109.0	33.3	74	166.4	50.9	34	223.8	68.4	94	281.1	85.9
55	52.6	16.1	15	110.0	33.6	75	167.3	51.2	35	224.7	68.7	95	282.1	86.1
56	53.5	16.4	16	110.9	33.9	76	168.3	51.4	36	225.7	69.0	96	283.0	86.4
57	54.5	16.7	17	111.9	34.2	77	169.3	51.7	37	226.6	69.3	97	284.0	86.7
58	55.5	17.0	18	112.8	34.5	78	170.2	52.0	38	227.6	69.6	98	285.0	87.0
59	56.4	17.2	19	113.8	34.8	79	171.2	52.3	39	228.5	69.9	99	285.9	87.3
60	57.4	17.5	20	114.7	35.1	80	172.1	52.6	40	229.5	70.2	300	286.9	87.6
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

E e

for 73 Degrees.

Difference of Latitude and Departure for 18 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	01.0	00.3	61	58.0	18.8	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	22	116.0	37.7	81	173.1	56.2	42	230.1	74.8
3	02.9	00.9	63	59.9	19.5	23	117.0	38.0	83	174.0	56.5	43	231.1	75.1
4	03.8	01.2	64	60.8	19.8	24	117.9	38.3	84	175.0	56.9	44	232.0	75.4
5	04.8	01.5	65	61.8	20.1	25	118.9	38.6	85	175.9	57.2	45	233.0	75.7
6	05.7	01.9	66	62.8	20.4	26	119.8	38.9	86	176.9	57.5	46	233.9	76.0
7	06.7	02.2	67	63.7	20.7	27	120.8	39.2	87	177.8	57.8	47	234.9	76.3
8	07.6	02.5	68	64.7	21.0	28	121.7	39.6	88	178.8	58.1	48	235.8	76.6
9	08.6	02.8	69	65.6	21.3	29	122.7	39.9	89	179.7	58.4	49	236.8	76.9
10	09.5	03.1	70	66.6	21.6	30	123.6	40.2	90	180.7	58.7	50	237.8	77.3
11	10.5	03.4	71	67.5	21.9	31	124.6	40.5	91	181.6	59.0	51	238.7	77.6
12	11.4	03.7	72	68.5	22.2	32	125.5	40.8	92	182.6	59.3	52	239.7	77.9
13	12.4	04.0	73	69.4	22.6	33	126.5	41.1	93	183.5	59.6	53	240.6	78.2
14	13.3	04.3	74	70.4	22.9	34	127.4	41.4	94	184.5	59.9	54	241.6	78.5
15	14.3	04.6	75	71.3	23.2	35	128.4	41.7	95	185.4	60.3	55	242.5	78.8
16	15.2	04.9	76	72.3	23.5	36	129.3	42.0	96	186.4	60.6	56	243.5	79.1
17	16.2	05.3	77	73.2	23.8	37	130.3	42.3	97	187.3	60.9	57	244.4	79.4
18	17.1	05.6	78	74.2	24.1	38	131.2	42.6	98	188.3	61.2	58	245.4	79.7
19	18.1	05.9	79	75.1	24.4	39	132.2	43.0	99	189.2	61.5	59	246.3	80.0
20	19.0	06.2	80	76.1	24.7	40	133.1	43.3	200	190.2	61.8	60	247.3	80.3
21	20.0	06.5	81	77.0	25.0	41	134.1	43.6	201	191.2	62.1	61	248.2	80.6
22	20.9	06.8	82	78.0	25.3	42	135.0	43.9	02	192.1	62.4	62	249.2	81.0
23	21.9	07.1	83	78.9	25.6	43	136.0	44.2	03	193.1	62.7	63	250.1	81.3
24	22.8	07.4	84	79.9	26.0	44	136.9	44.5	04	194.0	63.0	64	251.1	81.6
25	23.8	07.7	85	80.8	26.3	45	137.9	44.8	05	195.0	63.3	65	252.0	81.9
26	24.7	08.0	86	81.8	26.6	46	138.8	45.1	06	195.9	63.7	66	253.0	82.2
27	25.7	08.3	87	82.7	26.9	47	139.8	45.4	07	196.9	64.0	67	253.9	82.5
28	26.6	08.7	88	83.7	27.2	48	140.7	45.7	08	197.8	64.3	68	254.9	82.8
29	27.6	09.0	89	84.6	27.5	49	141.7	46.0	09	198.8	64.6	69	255.8	83.1
30	28.5	09.3	90	85.6	27.8	50	142.7	46.9	10	199.7	64.9	70	256.8	83.4
31	29.5	09.6	91	86.5	28.1	51	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	52	144.6	47.0	12	201.6	65.5	72	258.7	84.0
33	31.4	10.2	93	88.4	28.7	53	145.5	47.3	13	202.6	65.8	73	259.6	84.4
34	32.3	10.5	94	89.4	29.0	54	146.5	47.6	14	203.5	66.1	74	260.6	84.7
35	33.3	10.8	95	90.3	29.4	55	147.4	47.9	15	204.5	66.4	75	261.5	85.0
36	34.2	11.1	96	91.3	29.7	56	148.4	48.2	16	205.4	66.7	76	262.5	85.3
37	35.2	11.4	97	92.2	30.0	57	149.3	48.5	17	206.4	67.1	77	263.4	85.6
38	36.1	11.7	98	93.2	30.3	58	150.3	48.8	18	207.3	67.4	78	264.4	85.9
39	37.1	12.1	99	94.1	30.6	59	151.2	49.1	19	208.3	67.7	79	265.3	86.2
40	38.0	12.4	100	95.1	30.9	60	152.2	49.4	20	209.2	68.0	80	266.3	86.5
41	39.0	12.7	101	96.1	31.2	61	153.1	49.7	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	02	97.0	31.5	62	154.1	50.1	22	211.1	68.6	82	268.2	87.1
43	40.9	13.3	03	98.0	31.8	63	155.0	50.4	23	212.1	68.9	83	269.1	87.4
44	41.8	13.6	04	98.9	32.1	64	156.0	50.7	24	213.0	69.2	84	270.1	87.8
45	42.8	13.9	05	99.9	32.4	65	156.9	51.0	25	214.0	69.5	85	271.0	88.1
46	43.7	14.2	06	100.8	32.8	66	157.9	51.3	26	214.9	69.8	86	272.0	88.4
47	44.7	14.5	07	101.8	33.1	67	158.8	51.6	27	215.9	70.1	87	272.9	88.7
48	45.6	14.8	08	102.7	33.4	68	159.8	51.9	28	216.8	70.5	88	273.8	89.0
49	46.6	15.1	09	103.7	33.7	69	160.7	52.2	29	217.8	70.8	89	274.8	89.3
50	47.6	15.5	10	104.6	34.0	70	161.7	52.5	30	218.7	71.1	90	275.8	89.6
51	48.5	15.8	11	105.6	34.3	71	162.6	52.8	231	219.7	71.4	291	276.7	89.9
52	49.5	16.1	12	106.5	34.6	72	163.6	53.1	32	220.6	71.7	92	277.7	90.2
53	50.4	16.4	13	107.5	34.9	73	164.5	53.5	33	221.6	72.0	93	278.6	90.5
54	51.4	16.7	14	108.4	35.2	74	165.5	53.8	34	222.5	72.3	94	279.6	90.8
55	52.3	17.0	15	109.4	35.5	75	166.4	54.1	35	223.5	72.6	95	280.5	91.2
56	53.3	17.3	16	110.3	35.8	76	167.4	54.4	36	224.4	72.9	96	281.5	91.5
57	54.2	17.6	17	111.3	36.2	77	168.3	54.7	37	225.4	73.2	97	282.4	91.8
58	55.2	17.9	18	112.2	36.5	78	169.3	55.0	38	226.3	73.5	98	283.4	92.1
59	56.1	18.2	19	113.2	36.8	79	170.2	55.3	39	227.3	73.9	99	284.3	92.4
60	57.1	18.5	20	114.1	37.1	80	171.2	55.6	40	228.2	74.2	300	285.3	92.7
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 72 Degrees.

Difference of Latitude and Departure for 19 Degrees.

Difference of Latitude and Departure for 1 Degree														
Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.9	00.3	61	57.7	19.9	121	114.4	39.4	181	171.1	58.9	241	227.9	78.5
2	01.9	00.7	62	58.6	20.2	22	115.3	39.7	82	172.1	59.3	42	228.8	78.8
3	02.8	01.0	63	59.6	20.5	23	116.3	40.0	83	173.0	59.6	43	229.7	79.1
4	03.8	01.3	64	60.5	20.8	24	117.2	40.4	84	174.0	59.9	44	230.7	79.4
5	04.7	01.6	65	61.5	21.2	25	118.2	40.7	85	174.9	60.2	45	231.6	79.8
6	05.7	02.0	66	62.4	21.5	26	119.1	41.0	86	175.9	60.6	46	232.6	80.1
7	06.6	02.3	67	63.3	21.8	27	120.1	41.4	87	176.8	60.9	47	233.5	80.4
8	07.6	02.6	68	64.3	22.1	28	121.0	41.7	88	177.7	61.2	48	234.5	80.7
9	08.5	02.9	69	65.2	22.5	29	122.0	42.0	89	178.7	61.5	49	235.4	81.1
10	09.5	03.3	70	66.2	22.8	30	122.9	42.3	90	179.6	61.9	50	236.4	81.4
11	10.4	03.6	71	67.1	23.1	31	123.9	42.7	191	180.6	62.2	251	237.3	81.7
12	11.3	03.9	72	68.1	23.4	32	124.8	43.0	92	181.5	62.5	52	238.3	82.1
13	12.3	04.2	73	69.0	23.8	33	125.7	43.3	93	182.5	62.8	53	239.2	82.4
14	13.2	04.6	74	70.0	24.1	34	126.7	43.6	94	183.4	63.2	54	240.1	82.7
15	14.2	04.9	75	70.9	24.4	35	127.6	44.0	95	184.4	63.5	55	241.1	83.0
16	15.1	05.2	76	71.9	24.7	36	128.6	44.3	96	185.3	63.8	56	242.0	83.4
17	16.1	05.5	77	72.8	25.1	37	129.5	44.6	97	186.3	64.1	57	243.0	83.7
18	17.0	05.8	78	73.7	25.4	38	130.5	44.9	98	187.2	64.5	58	243.9	84.0
19	18.0	06.2	79	74.7	25.7	39	131.4	45.3	99	188.1	64.8	59	244.9	84.3
20	18.9	06.5	80	75.6	26.0	40	132.4	45.6	200	189.1	65.1	60	245.8	84.7
21	19.9	06.8	81	76.6	26.4	41	133.3	45.9	201	190.0	65.4	261	246.8	85.0
22	20.8	07.2	82	77.5	26.7	42	134.3	46.2	02	191.0	65.8	62	247.7	85.3
23	21.7	07.5	83	78.5	27.0	43	135.2	46.6	03	191.9	66.1	63	248.7	85.6
24	22.7	07.8	84	79.4	27.4	44	136.1	46.9	04	192.9	66.4	64	249.6	86.0
25	23.6	08.1	85	80.4	27.7	45	137.1	47.2	05	193.8	66.7	65	250.5	86.3
26	24.6	08.5	86	81.3	28.0	46	138.0	47.5	06	194.8	67.1	66	251.5	86.6
27	25.5	08.8	87	82.3	28.3	47	139.0	47.9	07	195.7	67.4	67	252.4	86.9
28	26.5	09.1	88	83.2	28.7	48	139.9	48.2	08	196.7	67.7	68	253.4	87.3
29	27.4	09.4	89	84.1	29.0	49	140.9	48.5	09	197.6	68.1	69	254.3	87.6
30	28.4	09.8	90	85.1	29.3	50	141.8	48.8	10	198.5	68.4	70	255.3	87.9
31	29.3	10.1	91	86.0	29.6	51	142.8	49.2	211	199.5	68.7	271	256.3	88.2
32	30.3	10.4	92	87.0	30.0	52	143.7	49.5	12	200.4	69.0	72	257.2	88.6
33	31.1	10.7	93	87.9	30.3	53	144.7	49.8	13	201.4	69.4	73	258.1	88.9
34	32.1	11.1	94	88.9	30.6	54	145.6	50.1	14	202.3	69.7	74	259.1	89.2
35	33.1	11.4	95	89.8	30.9	55	146.5	50.5	15	203.3	70.0	75	260.0	89.5
36	34.0	11.7	96	90.8	31.3	56	147.5	50.8	16	204.2	70.3	76	260.9	89.8
37	35.0	12.0	97	91.7	31.6	57	148.4	51.1	17	205.2	70.7	77	261.9	90.2
38	35.9	12.4	98	92.7	31.9	58	149.4	51.4	18	206.1	71.0	78	262.8	90.5
39	36.9	12.7	99	93.6	32.2	59	150.3	51.8	19	207.1	71.3	79	263.8	90.8
40	37.8	13.0	100	94.5	32.6	60	151.3	52.1	20	208.0	71.6	80	264.7	91.2
41	38.8	13.3	101	95.5	32.9	61	152.2	52.4	21	208.9	72.0	281	265.7	91.5
42	39.7	13.7	02	96.4	33.2	62	153.2	52.7	22	209.9	72.3	82	266.6	91.8
43	40.7	14.0	03	97.4	33.5	63	154.1	53.1	23	210.8	72.6	83	267.6	92.1
44	41.6	14.3	04	98.3	33.9	64	155.1	53.4	24	211.8	72.9	84	268.5	92.5
45	42.5	14.7	05	99.3	34.2	65	156.0	53.7	25	212.7	73.3	85	269.5	92.8
46	43.5	15.0	06	100.2	34.5	66	156.9	54.1	26	213.7	73.6	86	270.4	93.1
47	44.4	15.3	07	101.2	34.8	67	157.9	54.4	27	214.6	73.9	87	271.3	93.4
48	45.4	15.6	08	102.1	35.2	68	158.8	54.7	28	215.6	74.2	88	272.3	93.8
49	46.3	16.0	09	103.1	35.5	69	159.8	55.0	29	216.5	74.6	89	273.2	94.1
50	47.3	16.3	10	104.0	35.8	70	160.7	55.4	30	217.5	74.9	90	274.2	94.4
51	48.2	16.6	111	104.9	36.1	71	161.7	55.7	31	218.4	75.2	291	275.1	94.7
52	49.2	16.9	12	105.9	36.5	72	162.6	56.0	32	219.3	75.5	92	276.1	95.1
53	50.1	17.3	13	106.8	36.8	73	163.6	56.3	33	220.3	75.9	93	277.0	95.4
54	51.1	17.6	14	107.8	37.1	74	164.5	56.7	34	221.2	76.2	94	278.0	95.7
55	52.0	17.9	15	108.7	37.4	75	165.5	57.0	35	222.2	76.5	95	278.9	96.1
56	52.9	18.2	16	109.7	37.8	76	166.4	57.3	36	223.1	76.8	96	279.9	96.4
57	53.9	18.6	17	110.6	38.1	77	167.3	57.6	37	224.1	77.2	97	280.8	96.7
58	54.8	18.9	18	111.6	38.4	78	168.3	58.0	38	225.0	77.5	98	281.7	97.0
59	55.8	19.2	19	112.5	38.7	79	169.2	58.3	39	226.0	77.8	99	282.7	97.4
60	56.7	19.5	20	113.5	39.1	80	170.2	58.6	40	226.9	78.1	300	283.6	97.7
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

E e 2

for 71 Degrees.

Difference of Latitude and Departure for 20 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	122	114.6	41.7	182	171.0	62.2	242	227.4	82.8
3	02.8	01.0	63	59.2	21.5	123	115.6	42.1	183	172.0	62.6	243	228.3	83.1
4	03.8	01.4	64	60.1	21.9	124	116.5	42.4	184	172.9	62.9	244	229.3	83.4
5	04.7	01.7	65	61.1	22.2	125	117.5	42.8	185	173.8	63.3	245	230.2	83.8
6	05.6	02.1	66	62.0	22.6	126	118.4	43.1	186	174.8	63.6	246	231.2	84.1
7	06.6	02.4	67	63.0	22.9	127	119.3	43.4	187	175.7	64.0	247	232.1	84.5
8	07.5	02.7	68	63.9	23.3	128	120.3	43.8	188	176.7	64.3	248	233.0	84.8
9	08.5	03.1	69	64.8	23.6	129	121.2	44.1	189	177.6	64.6	249	234.0	85.2
10	09.4	03.4	70	65.8	23.9	130	122.2	44.5	190	178.5	65.0	250	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	132	124.0	45.1	192	180.4	65.7	252	236.8	86.2
13	12.2	04.4	73	68.6	25.0	133	125.0	45.5	193	181.4	66.0	253	237.7	86.5
14	13.2	04.8	74	69.5	25.3	134	125.9	45.8	194	182.3	66.3	254	238.7	86.9
15	14.1	05.1	75	70.5	25.7	135	126.9	46.2	195	183.2	66.7	255	239.6	87.2
16	15.0	05.5	76	71.4	26.0	136	127.8	46.5	196	184.2	67.0	256	240.6	87.6
17	16.0	05.8	77	72.4	26.3	137	128.7	46.9	197	185.1	67.4	257	241.5	87.9
18	16.9	06.2	78	73.3	26.7	138	129.7	47.2	198	186.1	67.7	258	242.4	88.2
19	17.9	06.5	79	74.2	27.0	139	130.6	47.5	199	187.0	68.1	259	243.4	88.6
20	18.8	06.8	80	75.2	27.4	140	131.6	47.9	200	187.9	68.4	260	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	142	133.4	48.6	202	189.8	69.1	262	246.2	89.6
23	21.6	07.9	83	78.0	28.4	143	134.4	48.9	203	190.8	69.4	263	247.1	89.9
24	22.6	08.2	84	78.9	28.7	144	135.3	49.2	204	191.7	69.8	264	248.1	90.3
25	23.5	08.6	85	79.9	29.1	145	136.3	49.6	205	192.6	70.1	265	249.0	90.6
26	24.4	08.9	86	80.8	29.4	146	137.2	49.9	206	193.6	70.5	266	250.0	91.0
27	25.4	09.2	87	81.8	29.8	147	138.1	50.3	207	194.5	70.8	267	250.9	91.3
28	26.3	09.6	88	82.7	30.1	148	139.1	50.6	208	195.5	71.1	268	251.8	91.7
29	27.3	09.9	89	83.6	30.4	149	140.0	51.0	209	196.4	71.5	269	252.8	92.0
30	28.2	10.3	90	84.6	30.8	150	141.0	51.3	210	197.3	71.8	270	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	152	142.8	52.0	212	199.2	72.5	272	255.6	93.0
33	31.0	11.3	93	87.4	31.8	153	143.8	52.3	213	200.2	72.8	273	256.5	93.4
34	31.9	11.6	94	88.3	32.1	154	144.7	52.7	214	201.1	73.2	274	257.5	93.7
35	32.9	12.0	95	89.3	32.5	155	145.7	53.0	215	202.0	73.5	275	258.4	94.1
36	33.8	12.3	96	90.2	32.8	156	146.6	53.4	216	203.0	73.9	276	259.4	94.4
37	34.8	12.7	97	91.2	33.2	157	147.5	53.7	217	203.9	74.2	277	260.3	94.7
38	35.7	13.0	98	92.1	33.5	158	148.5	54.0	218	204.9	74.6	278	261.2	95.1
39	36.6	13.3	99	93.0	33.9	159	149.4	54.4	219	205.8	74.9	279	262.2	95.4
40	37.6	13.7	100	94.0	34.2	160	150.4	54.7	220	206.7	75.2	280	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	102	95.8	34.9	162	152.2	55.4	222	208.6	75.9	282	265.0	96.4
43	40.4	14.7	103	96.8	35.2	163	153.2	55.7	223	209.6	76.3	283	265.9	96.8
44	41.3	15.0	104	97.7	35.6	164	154.1	56.1	224	210.5	76.6	284	266.9	97.1
45	42.3	15.4	105	98.7	35.9	165	155.1	56.4	225	211.4	77.0	285	267.8	97.5
46	43.2	15.7	106	99.6	36.3	166	156.0	56.8	226	212.4	77.3	286	268.8	97.8
47	44.2	16.1	107	100.5	36.6	167	156.9	57.1	227	213.3	77.6	287	269.7	98.2
48	45.1	16.4	108	101.5	36.9	168	157.9	57.5	228	214.3	78.0	288	270.6	98.5
49	46.0	16.8	109	102.4	37.3	169	158.8	57.8	229	215.2	78.3	289	271.6	98.8
50	47.0	17.1	110	103.4	37.6	170	159.7	58.1	230	216.1	78.7	290	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	112	105.2	38.3	172	161.6	58.8	232	218.0	79.3	292	274.4	99.9
53	49.8	18.1	113	106.2	38.6	173	162.6	59.2	233	219.0	79.7	293	275.3	100.2
54	50.7	18.5	114	107.1	39.0	174	163.5	59.5	234	219.9	80.0	294	276.3	100.5
55	51.7	18.8	115	108.1	39.3	175	164.4	59.9	235	220.8	80.4	295	277.2	100.9
56	52.6	19.2	116	109.0	39.7	176	165.4	60.2	236	221.8	80.7	296	278.2	101.1
57	53.6	19.5	117	109.9	40.0	177	166.3	60.5	237	222.7	81.1	297	279.1	101.6
58	54.5	19.8	118	110.9	40.4	178	167.3	60.9	238	223.6	81.4	298	280.0	101.9
59	55.4	20.2	119	111.8	40.7	179	168.2	61.2	239	224.6	81.7	299	281.0	102.3
60	56.4	20.5	120	112.8	41.0	180	169.1	61.6	240	225.5	82.1	300	281.9	102.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 70 Degrees.

Difference of Latitude and Departure for 21 Degrees.

Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	22	113.9	43.7	82	169.9	65.2	42	225.9	86.7
3	02.8	01.1	63	58.8	22.6	23	114.9	44.1	83	170.9	65.2	43	226.6	87.1
4	03.7	01.4	64	59.7	22.9	24	115.8	44.4	84	171.8	65.9	44	227.8	87.4
5	04.7	01.8	65	60.7	23.3	25	116.7	44.8	85	172.7	66.3	45	228.7	87.8
6	05.6	02.2	66	61.6	23.7	26	117.7	45.2	86	173.7	66.7	46	229.7	88.2
7	06.5	02.5	67	62.5	24.0	27	118.6	45.5	87	174.6	67.0	47	230.6	88.5
8	07.5	02.9	68	63.5	24.4	28	119.5	45.9	88	175.5	67.4	48	231.5	88.9
9	08.4	03.2	69	64.4	24.7	29	120.5	46.2	89	176.5	67.7	49	232.5	89.2
10	09.3	03.6	70	65.3	25.1	30	121.4	46.6	90	177.4	68.1	50	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	47.0	191	178.3	68.5	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	32	123.3	47.9	92	179.3	68.8	52	235.3	90.3
13	12.1	04.6	73	68.1	26.2	33	124.2	47.7	93	180.2	69.2	53	236.2	90.7
14	13.1	05.0	74	69.1	26.5	34	125.1	48.0	94	181.1	69.5	54	237.1	91.0
15	14.0	05.4	75	70.0	26.9	35	126.1	48.4	95	182.1	69.9	55	238.1	91.4
16	14.9	05.7	76	70.9	26.2	36	127.0	48.7	96	183.0	70.2	56	239.0	91.8
17	15.9	06.1	77	71.9	27.6	37	127.9	49.1	97	183.9	70.6	57	239.0	92.1
18	16.8	06.5	78	72.8	28.0	38	128.9	49.5	98	184.9	71.0	58	240.9	92.5
19	17.7	06.8	79	73.7	28.3	39	129.8	49.8	99	185.8	71.3	59	241.8	92.8
20	18.7	07.2	80	74.7	28.7	40	130.7	50.2	200	186.7	71.7	60	242.7	93.2
21	19.6	07.5	81	75.6	29.0	141	131.7	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.5	29.4	42	132.6	50.9	02	188.6	72.4	62	244.6	93.9
23	21.5	08.2	83	77.5	29.7	43	133.5	51.3	03	189.5	72.8	63	245.5	94.3
24	22.4	08.6	84	78.4	30.1	44	134.5	51.6	04	190.4	73.1	64	246.5	94.6
25	23.3	09.0	85	79.3	30.5	45	135.4	52.0	05	191.4	73.5	65	247.4	95.0
26	24.3	09.3	86	80.3	30.8	46	136.3	52.3	06	192.3	73.8	66	248.3	95.3
27	25.2	09.7	87	81.2	31.2	47	137.3	52.7	07	193.2	74.2	67	249.3	95.7
28	26.1	10.0	88	82.1	31.5	48	138.2	53.0	08	194.2	74.5	68	250.2	96.1
29	27.1	10.4	89	83.1	31.9	49	139.1	53.4	09	195.1	74.9	69	251.1	96.4
30	28.0	10.8	90	84.0	32.3	50	140.1	53.8	10	196.0	75.3	70	252.1	96.8
31	28.9	11.1	91	84.9	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	52	141.9	54.5	12	197.9	76.0	72	253.9	97.5
33	30.8	11.8	93	86.8	33.3	53	142.9	54.8	13	198.8	76.3	73	254.9	97.8
34	31.7	12.2	94	87.7	33.7	54	143.8	55.2	14	199.8	76.7	74	255.8	98.2
35	32.7	12.5	95	88.7	34.0	55	144.7	55.6	15	200.7	77.1	75	256.7	98.6
36	33.6	12.9	96	89.6	34.4	56	145.7	55.9	16	201.6	77.3	76	257.7	98.9
37	34.5	13.3	97	90.5	34.8	57	146.6	56.3	17	202.6	77.8	77	258.6	99.3
38	35.5	13.6	98	91.5	35.1	58	147.5	56.6	18	203.5	78.1	78	259.5	99.6
39	36.4	14.0	99	92.4	35.5	59	148.5	57.0	19	204.4	78.5	79	260.5	100.0
40	37.3	14.3	100	93.4	35.8	60	149.4	57.3	20	205.4	78.8	80	261.4	100.4
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	02	95.3	36.6	62	151.3	58.1	22	207.2	79.6	82	263.3	101.1
43	40.1	15.4	03	96.2	36.9	63	152.2	58.4	23	208.2	79.9	83	264.2	101.4
44	41.1	15.8	04	97.1	37.3	64	153.1	58.8	24	209.1	80.3	84	265.1	101.8
45	42.0	16.1	05	98.1	37.6	65	154.1	59.1	25	210.0	80.6	85	266.1	102.1
46	42.9	16.5	06	99.0	38.0	66	155.0	59.5	26	211.0	81.0	86	267.0	102.5
47	43.9	16.8	07	99.9	38.3	67	155.9	59.9	27	211.9	81.4	87	267.9	102.9
48	44.8	17.2	08	100.9	38.7	68	156.9	60.2	28	212.8	81.7	88	268.9	103.2
49	45.7	17.6	09	101.8	39.1	69	157.8	60.6	29	213.8	82.1	89	269.8	103.6
50	46.7	17.9	10	102.7	39.4	70	158.7	60.9	30	214.7	82.4	90	270.7	103.9
51	47.6	18.3	111	103.7	39.8	171	159.7	61.3	231	215.6	82.8	291	271.7	104.3
52	48.5	18.6	12	104.6	40.1	72	160.6	61.6	32	216.6	83.1	92	272.6	104.7
53	49.5	19.0	13	105.5	40.5	73	161.5	62.0	33	217.5	83.5	93	273.5	105.0
54	50.4	19.4	14	106.5	40.9	74	162.5	62.4	34	218.4	83.9	94	274.5	105.4
55	51.3	19.7	15	107.4	41.2	75	163.4	62.7	35	219.4	84.2	95	275.4	105.7
56	52.3	20.1	16	108.3	41.6	76	164.3	63.1	36	220.3	84.6	96	276.3	106.1
57	53.2	20.4	17	109.3	41.9	77	165.3	63.4	37	221.2	84.9	97	277.3	106.4
58	54.1	20.8	18	110.2	42.3	78	166.2	63.8	38	222.2	85.3	98	278.2	106.8
59	55.1	21.1	19	111.1	42.6	79	167.1	64.2	39	223.1	85.7	99	279.1	107.2
60	56.0	21.5	20	112.1	43.0	80	168.1	64.5	40	224.1	86.0	300	280.1	107.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 69 Degrees.

Difference of Latitude and Departure for 22 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	122	113.1	45.7	182	168.8	68.2	242	224.4	90.7
3	02.8	01.1	63	58.4	23.6	123	114.0	46.1	183	169.7	68.6	243	225.3	91.0
4	03.7	01.5	64	59.3	24.0	124	115.0	46.5	184	170.6	68.9	244	226.2	91.4
5	04.6	01.9	65	60.3	24.3	125	115.9	46.8	185	171.5	69.3	245	227.2	91.8
6	05.6	02.2	66	61.2	24.7	126	116.8	47.2	186	172.5	69.7	246	228.1	92.2
7	06.5	02.6	67	62.1	25.1	127	117.8	47.6	187	173.4	70.1	247	229.0	92.5
8	07.4	03.0	68	63.0	25.5	128	118.7	47.9	188	174.3	70.4	248	229.9	92.9
9	08.3	03.4	69	64.0	25.8	129	119.6	48.3	189	175.2	70.8	249	230.9	93.3
10	09.3	03.7	70	64.9	26.2	130	120.5	48.7	190	176.2	71.2	250	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	132	122.4	49.4	192	178.0	71.9	252	233.7	94.4
13	12.1	04.9	73	67.7	27.3	133	123.3	49.8	193	178.9	72.3	253	234.6	94.8
14	13.0	05.2	74	68.6	27.7	134	124.2	50.2	194	179.8	72.7	254	235.5	95.2
15	13.9	05.6	75	69.5	28.1	135	125.2	50.6	195	180.8	73.0	255	236.4	95.5
16	14.8	06.0	76	70.5	28.5	136	126.1	50.9	196	181.7	73.4	256	237.4	95.9
17	15.8	06.4	77	71.4	28.8	137	127.0	51.3	197	182.7	73.8	257	238.3	96.3
18	16.7	06.7	78	72.3	29.2	138	128.0	51.7	198	183.6	74.2	258	239.2	96.6
19	17.6	07.1	79	73.2	29.6	139	128.9	52.1	199	184.5	74.5	259	240.1	97.0
20	18.5	07.5	80	74.2	30.0	140	129.8	52.4	200	185.4	74.9	260	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	142	131.7	53.2	202	187.3	75.7	262	242.9	98.1
23	21.3	08.6	83	77.0	31.1	143	132.6	53.6	203	188.2	76.0	263	243.9	98.5
24	22.3	09.0	84	77.9	31.5	144	133.5	53.9	204	189.1	76.4	264	244.8	98.9
25	23.2	09.4	85	78.8	31.8	145	134.4	54.3	205	190.1	76.8	265	245.7	99.3
26	24.1	09.7	86	79.7	32.2	146	135.4	54.7	206	191.0	77.2	266	246.6	99.6
27	25.0	10.1	87	80.7	32.6	147	136.3	55.1	207	191.9	77.5	267	247.6	100.0
28	26.0	10.5	88	81.6	33.0	148	137.2	55.4	208	192.9	77.9	268	248.5	100.4
29	26.9	10.9	89	82.5	33.3	149	138.2	55.8	209	193.8	78.3	269	249.4	100.8
30	27.8	11.2	90	83.4	33.7	150	139.1	56.2	210	194.7	78.7	270	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	152	140.9	56.9	212	196.6	79.4	272	252.2	101.9
33	30.6	12.4	93	86.2	34.8	153	141.9	57.3	213	197.5	79.8	273	253.1	102.3
34	31.5	12.7	94	87.2	35.2	154	142.8	57.7	214	198.4	80.2	274	254.1	102.6
35	32.5	13.1	95	88.1	35.6	155	143.7	58.1	215	199.3	80.5	275	255.0	103.0
36	33.4	13.5	96	89.0	36.0	156	144.6	58.4	216	200.3	80.9	276	255.9	103.4
37	34.3	13.9	97	89.9	36.3	157	145.6	58.8	217	201.2	81.3	277	256.8	103.8
38	35.2	14.2	98	90.9	36.7	158	146.5	59.2	218	202.1	81.7	278	257.8	104.1
39	36.2	14.6	99	91.8	37.1	159	147.4	59.6	219	203.1	82.0	279	258.7	104.5
40	37.1	15.0	100	92.7	37.5	160	148.4	59.9	220	204.0	82.4	280	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	204.9	82.8	281	260.5	105.3
42	38.9	15.7	102	94.6	38.2	162	150.2	60.7	222	205.8	83.2	282	261.5	105.6
43	39.9	16.1	103	95.5	38.6	163	151.1	61.1	223	206.7	83.5	283	262.4	106.0
44	40.8	16.5	104	96.4	39.0	164	152.1	61.4	224	207.7	83.9	284	263.3	106.4
45	41.7	16.9	105	97.4	39.3	165	153.0	61.8	225	208.6	84.3	285	264.3	106.8
46	42.7	17.2	106	98.3	39.7	166	153.9	62.2	226	209.5	84.7	286	265.2	107.1
47	43.6	17.6	107	99.2	40.1	167	154.8	62.6	227	210.5	85.0	287	266.1	107.5
48	44.5	18.0	108	100.1	40.5	168	155.8	62.9	228	211.4	85.4	288	267.0	107.9
49	45.4	18.4	109	101.1	40.8	169	156.7	63.3	229	212.3	85.8	289	268.0	108.3
50	46.4	18.7	110	102.0	41.2	170	157.6	63.7	230	213.3	86.2	290	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.6	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	112	103.8	42.0	172	159.5	64.4	232	215.1	86.9	292	270.7	109.4
53	49.1	19.9	113	104.8	42.3	173	160.4	64.8	233	216.0	87.3	293	271.7	109.8
54	50.1	20.2	114	105.7	42.7	174	161.3	65.2	234	217.0	87.7	294	272.6	110.1
55	51.0	20.6	115	106.6	43.1	175	162.3	65.6	235	217.9	88.0	295	273.5	110.5
56	51.9	21.0	116	107.6	43.5	176	163.2	65.9	236	218.8	88.4	296	274.5	110.9
57	52.9	21.4	117	108.5	43.8	177	164.1	66.3	237	219.7	88.8	297	275.4	111.3
58	53.8	21.7	118	109.4	44.2	178	165.0	66.7	238	220.7	89.2	298	276.3	111.6
59	54.7	22.1	119	110.3	44.6	179	166.0	67.1	239	221.6	89.5	299	277.2	112.0
60	55.6	22.5	120	111.3	45.0	180	166.9	67.4	240	222.5	89.9	300	278.2	112.4
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 68 Degrees.

Difference of Latitude and Departure for 23 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.9	00.4	61	56.1	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.4
2	01.8	00.8	62	57.1	24.2	122	112.3	47.7	182	167.5	71.1	242	222.8	94.5
3	02.8	01.2	63	58.0	24.6	123	113.2	48.1	183	168.5	71.5	243	223.7	94.9
4	03.7	01.6	64	58.9	25.0	124	114.1	48.4	184	169.4	71.9	244	224.6	95.3
5	04.6	02.0	65	59.8	25.4	125	115.1	48.8	185	170.3	72.3	245	225.5	95.7
6	05.5	02.3	66	60.8	25.8	126	116.0	49.2	186	171.2	72.7	246	226.4	96.1
7	06.4	02.7	67	61.7	26.2	127	116.9	49.6	187	172.2	73.1	247	227.4	96.5
8	07.4	03.1	68	62.6	26.6	128	117.8	50.0	188	173.1	73.5	248	228.3	96.9
9	08.3	03.5	69	63.5	27.0	129	118.7	50.4	189	174.0	73.8	249	229.2	97.3
10	09.2	03.9	70	64.4	27.3	130	119.7	50.8	190	174.9	74.2	250	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	132	121.5	51.6	192	176.7	75.0	252	232.0	98.5
13	12.0	05.1	73	67.2	28.5	133	122.4	52.0	193	177.7	75.4	253	232.9	98.8
14	12.9	05.5	74	68.1	28.9	134	123.3	52.4	194	178.6	75.8	254	233.8	99.2
15	13.8	05.9	75	69.0	29.3	135	124.3	52.7	195	179.5	76.2	255	234.7	99.6
16	14.7	06.3	76	70.0	29.7	136	125.2	53.1	196	180.4	76.6	256	235.6	100.0
17	15.6	06.6	77	70.9	30.1	137	126.1	53.5	197	181.3	77.0	257	236.6	100.3
18	16.6	07.0	78	71.8	30.5	138	127.0	53.9	198	182.3	77.4	258	237.5	100.8
19	17.5	07.4	79	72.7	30.9	139	127.9	54.3	199	183.2	77.7	259	238.4	101.2
20	18.4	07.8	80	73.6	31.3	140	128.9	54.7	200	184.1	78.1	260	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.2	102.0
22	20.3	08.6	82	75.5	32.0	142	130.7	55.5	202	185.9	78.9	262	241.2	102.4
23	21.2	09.0	83	76.4	32.4	143	131.6	55.9	203	186.9	79.3	263	242.1	102.8
24	22.1	09.4	84	77.3	32.8	144	132.6	56.3	204	187.8	79.7	264	243.0	103.1
25	23.0	09.8	85	78.2	33.2	145	133.5	56.7	205	188.7	80.1	265	243.9	103.5
26	23.9	10.2	86	79.2	33.6	146	134.4	57.0	206	189.6	80.5	266	244.9	103.9
27	24.9	10.5	87	80.1	34.0	147	135.3	57.4	207	190.5	80.9	267	245.8	104.3
28	25.8	10.9	88	81.0	34.4	148	136.2	57.8	208	191.5	81.3	268	246.7	104.7
29	26.7	11.3	89	81.9	34.8	149	137.2	58.2	209	192.4	81.7	269	247.6	105.1
30	27.6	11.7	90	82.8	35.2	150	138.1	58.6	210	193.3	82.0	270	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	152	139.9	59.4	212	195.1	82.8	272	250.4	106.3
33	30.4	12.9	93	85.6	36.3	153	140.8	59.8	213	196.1	83.2	273	251.3	106.7
34	31.3	13.3	94	86.5	36.7	154	141.8	60.2	214	197.0	83.6	274	252.2	107.1
35	32.2	13.7	95	87.4	37.1	155	142.7	60.6	215	197.9	84.0	275	253.1	107.4
36	33.1	14.1	96	88.4	37.5	156	143.6	60.9	216	198.8	84.4	276	254.1	107.8
37	34.1	14.5	97	89.3	37.9	157	144.5	61.3	217	199.7	84.8	277	255.0	108.2
38	35.0	14.8	98	90.2	38.3	158	145.4	61.7	218	200.7	85.2	278	255.9	108.6
39	35.9	15.2	99	91.1	38.7	159	146.4	62.1	219	201.6	85.6	279	256.8	109.0
40	36.8	15.6	100	92.0	39.1	160	147.3	62.5	220	202.5	86.0	280	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.3	281	258.7	109.8
42	38.7	16.4	102	93.9	39.9	162	149.1	63.3	222	204.4	86.7	282	259.6	110.2
43	39.6	16.8	103	94.8	40.2	163	150.0	63.7	223	205.3	87.1	283	260.5	110.6
44	40.5	17.2	104	95.7	40.6	164	151.0	64.1	224	206.2	87.5	284	261.4	111.0
45	41.4	17.6	105	96.7	41.0	165	151.9	64.5	225	207.1	87.9	285	262.3	111.3
46	42.3	18.0	106	97.6	41.4	166	152.8	64.9	226	208.0	88.3	286	263.3	111.7
47	43.3	18.4	107	98.5	41.8	167	153.7	65.2	227	209.0	88.7	287	264.2	112.1
48	44.2	18.8	108	99.4	42.2	168	154.6	65.6	228	209.9	89.1	288	265.1	112.5
49	45.1	19.1	109	100.3	42.6	169	155.6	66.0	229	210.8	89.5	289	266.0	112.9
50	46.0	19.5	110	101.3	43.0	170	156.5	66.4	230	211.7	89.9	290	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	112	103.2	43.8	172	158.3	67.2	232	213.6	90.6	292	268.8	114.1
53	48.8	20.7	113	104.0	44.1	173	159.2	67.6	233	214.5	91.0	293	269.7	114.5
54	49.7	21.1	114	104.9	44.5	174	160.2	68.0	234	215.4	91.4	294	270.6	114.9
55	50.6	21.5	115	105.9	44.9	175	161.1	68.4	235	216.3	91.8	295	271.5	115.3
56	51.5	21.9	116	106.8	45.3	176	162.0	68.8	236	217.2	92.2	296	272.5	115.6
57	52.5	22.3	117	107.7	45.7	177	162.9	69.2	237	218.2	92.6	297	273.4	116.0
58	53.4	22.7	118	108.6	46.1	178	163.8	69.5	238	219.1	93.0	298	274.3	116.4
59	54.3	23.1	119	109.5	46.5	179	164.8	69.9	239	220.0	93.4	299	275.2	116.8
60	55.2	23.4	120	110.5	46.9	180	165.7	70.3	240	220.9	93.8	300	276.2	117.2
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 67 Degrees.

Difference of Latitude and Departure for 24 Degrees.

D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.3	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	122	111.4	49.6	182	166.3	74.0	42	221.1	98.4
3	02.7	01.2	63	57.6	25.6	123	112.4	50.0	183	167.2	74.4	43	222.0	98.8
4	03.7	01.6	64	58.5	26.0	124	113.3	50.4	184	168.1	74.8	44	222.9	99.2
5	04.6	02.0	65	59.4	26.4	125	114.2	50.8	185	169.0	75.2	45	223.8	99.6
6	05.5	02.4	66	60.3	26.8	126	115.1	51.2	186	169.9	75.6	46	224.7	100.0
7	06.4	02.8	67	61.2	27.2	127	116.0	51.7	187	170.8	76.1	47	225.6	100.5
8	07.3	03.3	68	62.1	27.7	128	116.9	52.1	188	171.7	76.5	48	226.5	100.9
9	08.2	03.7	69	63.0	28.1	129	117.8	52.5	189	172.7	76.9	49	227.5	101.3
10	09.1	04.1	70	63.9	28.5	130	118.8	52.9	190	173.6	77.3	50	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	51	229.3	102.1
12	11.0	04.9	72	65.8	29.3	132	120.6	53.7	192	175.4	78.1	52	230.2	102.5
13	11.9	05.3	73	66.7	29.7	133	121.5	54.1	193	176.3	78.5	53	231.1	102.9
14	12.8	05.7	74	67.6	30.1	134	122.4	54.5	194	177.2	78.9	54	232.0	103.3
15	13.7	06.1	75	68.5	30.5	135	123.3	54.9	195	178.1	79.3	55	232.9	103.7
16	14.6	06.5	76	69.4	30.9	136	124.2	55.3	196	179.0	79.7	56	233.8	104.1
17	15.5	06.9	77	70.3	31.3	137	125.1	55.7	197	180.0	80.1	57	234.7	104.5
18	16.4	07.3	78	71.2	31.7	138	126.0	56.1	198	180.9	80.5	58	235.6	104.9
19	17.4	07.7	79	72.1	32.1	139	127.0	56.5	199	181.8	80.9	59	236.5	105.3
20	18.3	08.1	80	73.0	32.5	140	127.9	56.9	200	182.7	81.3	60	237.4	105.7
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.7	61	238.3	106.1
22	20.1	08.9	82	74.9	33.3	142	129.7	57.8	202	184.5	82.2	62	239.2	106.6
23	21.0	09.4	83	75.8	33.8	143	130.6	58.2	203	185.4	82.6	63	240.1	107.0
24	21.9	09.8	84	76.7	34.2	144	131.5	58.6	204	186.3	83.0	64	241.0	107.4
25	22.8	10.2	85	77.6	34.6	145	132.4	59.0	205	187.2	83.4	65	241.9	107.8
26	23.8	10.6	86	78.5	35.0	146	133.3	59.4	206	188.1	83.8	66	242.8	108.2
27	24.7	11.0	87	79.4	35.4	147	134.2	59.8	207	189.0	84.2	67	243.7	108.6
28	25.6	11.4	88	80.3	35.8	148	135.1	60.2	208	190.0	84.6	68	244.6	109.0
29	26.5	11.8	89	81.2	36.2	149	136.0	60.6	209	190.9	85.0	69	245.5	109.4
30	27.4	12.2	90	82.1	36.6	150	137.0	61.0	210	191.8	85.4	70	246.4	109.8
31	28.3	12.6	91	83.0	37.0	151	137.9	61.4	211	192.7	85.8	71	247.3	110.2
32	29.2	13.0	92	84.0	37.4	152	138.8	61.8	212	193.6	86.2	72	248.2	110.6
33	30.1	13.4	93	85.0	37.8	153	139.7	62.2	213	194.5	86.6	73	249.1	111.0
34	31.1	13.8	94	85.9	38.2	154	140.6	62.6	214	195.4	87.0	74	250.0	111.4
35	32.0	14.2	95	86.8	38.6	155	141.5	63.0	215	196.3	87.4	75	250.9	111.8
36	32.9	14.6	96	87.7	39.0	156	142.4	63.4	216	197.2	87.8	76	251.8	112.2
37	33.8	15.0	97	88.6	39.4	157	143.3	63.8	217	198.1	88.2	77	252.7	112.6
38	34.7	15.4	98	89.5	39.8	158	144.2	64.2	218	199.0	88.6	78	253.6	113.0
39	35.6	15.8	99	90.4	40.2	159	145.1	64.6	219	200.0	89.0	79	254.5	113.4
40	36.5	16.2	100	91.3	40.6	160	146.0	65.0	220	200.9	89.4	80	255.4	113.8
41	37.4	16.6	101	92.2	41.0	161	146.9	65.4	221	201.8	89.8	81	256.3	114.2
42	38.3	17.0	102	93.1	41.4	162	147.8	65.8	222	202.7	90.2	82	257.2	114.6
43	39.2	17.4	103	94.0	41.8	163	148.7	66.2	223	203.6	90.6	83	258.1	115.0
44	40.1	17.8	104	94.9	42.2	164	149.6	66.6	224	204.5	91.0	84	259.0	115.4
45	41.0	18.2	105	95.8	42.6	165	150.5	67.0	225	205.4	91.4	85	260.0	115.8
46	41.9	18.6	106	96.7	43.0	166	151.4	67.4	226	206.3	91.8	86	260.9	116.2
47	42.8	19.0	107	97.6	43.4	167	152.3	67.8	227	207.2	92.2	87	261.8	116.6
48	43.7	19.4	108	98.5	43.8	168	153.2	68.2	228	208.1	92.6	88	262.7	117.0
49	44.6	19.8	109	99.4	44.2	169	154.1	68.6	229	209.0	93.0	89	263.6	117.4
50	45.5	20.2	110	100.3	44.6	170	155.0	69.0	230	210.0	93.4	90	264.5	117.8
51	46.4	20.6	111	101.2	45.0	171	155.9	69.4	231	210.9	93.8	91	265.4	118.2
52	47.3	21.0	112	102.1	45.4	172	156.8	69.8	232	211.8	94.2	92	266.3	118.6
53	48.2	21.4	113	103.0	45.8	173	157.7	70.2	233	212.7	94.6	93	267.2	119.0
54	49.1	21.8	114	103.9	46.2	174	158.6	70.6	234	213.6	95.0	94	268.1	119.4
55	50.0	22.2	115	104.8	46.6	175	159.5	71.0	235	214.5	95.4	95	269.0	119.8
56	50.9	22.6	116	105.7	47.0	176	160.4	71.4	236	215.4	95.8	96	270.0	120.2
57	51.8	23.0	117	106.6	47.4	177	161.3	71.8	237	216.3	96.2	97	270.9	120.6
58	52.7	23.4	118	107.5	47.8	178	162.2	72.2	238	217.2	96.6	98	271.8	121.0
59	53.6	23.8	119	108.4	48.2	179	163.1	72.6	239	218.1	97.0	99	272.7	121.4
60	54.5	24.2	120	109.3	48.6	180	164.0	73.0	240	219.0	97.4	100	273.6	121.8
D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.	D. A.	Lat.	Dep.

for 68 Degrees.

Difference of Latitude and Departure for 25 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.8
2	01.8	00.8	62	56.2	26.2	22	110.6	51.6	82	164.9	76.9	42	219.3	102.3
3	02.7	01.3	63	57.1	26.6	23	111.5	52.0	83	165.9	77.3	43	220.2	102.7
4	03.6	01.7	64	58.0	27.0	24	112.4	52.4	84	166.8	77.8	44	221.1	103.1
5	04.5	02.1	65	58.9	27.5	25	113.3	52.8	85	167.7	78.2	45	222.0	103.5
6	05.4	02.5	66	59.8	27.9	26	114.2	53.2	86	168.6	78.6	46	222.9	104.0
7	06.3	03.0	67	60.7	28.3	27	115.1	53.7	87	169.5	79.0	47	223.9	104.4
8	07.3	03.4	68	61.6	28.7	28	116.0	54.1	88	170.4	79.4	48	224.8	104.8
9	08.2	03.8	69	62.5	29.2	29	116.9	54.5	89	171.3	79.9	49	225.7	105.2
10	09.1	04.2	70	63.4	29.6	30	117.8	54.9	90	172.2	80.3	50	226.6	105.7
11	10.0	04.6	71	64.3	30.0	31	118.7	55.4	91	173.1	80.7	51	227.5	106.1
12	10.9	05.0	72	65.3	30.4	32	119.6	55.8	92	174.0	81.1	52	228.4	106.5
13	11.8	05.5	73	66.2	30.8	33	120.5	56.2	93	174.9	81.6	53	229.3	106.9
14	12.7	05.9	74	67.1	31.3	34	121.4	56.6	94	175.8	82.0	54	230.2	107.3
15	13.6	06.3	75	68.0	31.7	35	122.4	57.1	95	176.7	82.4	55	231.1	107.8
16	14.5	06.8	76	68.9	32.1	36	123.3	57.5	96	177.6	82.8	56	232.0	108.2
17	15.4	07.2	77	69.8	32.5	37	124.2	57.9	97	178.5	83.3	57	232.9	108.6
18	16.3	07.6	78	70.7	33.0	38	125.1	58.3	98	179.4	83.7	58	233.8	109.0
19	17.2	08.0	79	71.6	33.4	39	126.0	58.7	99	180.4	84.1	59	234.7	109.5
20	18.1	08.5	80	72.5	33.8	40	126.9	59.2	200	181.3	84.5	60	235.6	109.9
21	19.0	08.9	81	73.4	34.2	41	127.8	59.6	201	182.2	84.9	61	236.5	110.3
22	19.9	09.3	82	74.3	34.7	42	128.7	60.0	02	183.1	85.4	62	237.5	110.7
23	20.8	09.7	83	75.2	35.1	43	129.6	60.4	03	184.0	85.8	63	238.4	111.1
24	21.8	10.1	84	76.1	35.5	44	130.5	60.9	04	184.9	86.2	64	239.3	111.6
25	22.7	10.6	85	77.0	35.9	45	131.4	61.3	05	185.8	86.6	65	240.2	112.0
26	23.6	11.0	86	77.9	36.3	46	132.3	61.7	06	186.7	87.1	66	241.1	112.4
27	24.5	11.4	87	78.8	36.8	47	133.2	62.1	07	187.6	87.5	67	242.0	112.8
28	25.4	11.8	88	79.8	37.2	48	134.1	62.5	08	188.5	87.9	68	242.9	113.3
29	26.3	12.3	89	80.7	37.6	49	135.0	63.0	09	189.4	88.3	69	243.8	113.7
30	27.2	12.7	90	81.6	38.0	50	135.9	63.4	10	190.3	88.7	70	244.7	114.1
31	28.1	13.1	91	82.5	38.5	51	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	52	137.8	64.2	12	192.1	89.6	72	246.5	114.9
33	29.9	13.9	93	84.3	39.3	53	138.7	64.7	13	193.0	90.0	73	247.4	115.4
34	30.8	14.4	94	85.2	39.7	54	139.6	65.1	14	193.9	90.4	74	248.3	115.8
35	31.7	14.8	95	86.1	40.1	55	140.5	65.5	15	194.9	90.9	75	249.2	116.2
36	32.6	15.2	96	87.0	40.6	56	141.4	65.9	16	195.8	91.3	76	250.1	116.6
37	33.5	15.6	97	87.9	41.0	57	142.3	66.3	17	196.7	91.7	77	251.0	117.1
38	34.4	16.1	98	88.8	41.4	58	143.2	66.8	18	197.6	92.1	78	252.0	117.5
39	35.3	16.5	99	89.7	41.8	59	144.1	67.2	19	198.5	92.5	79	252.9	117.9
40	36.3	16.9	100	90.6	42.3	60	145.0	67.6	20	199.4	93.0	80	253.8	118.3
41	37.2	17.3	101	91.5	42.7	61	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	02	92.4	43.1	62	146.8	68.5	22	201.2	93.8	82	255.6	119.2
43	39.0	18.2	03	93.3	43.5	63	147.7	68.9	23	202.1	94.2	83	256.5	119.6
44	39.9	18.6	04	94.3	44.0	64	148.6	69.3	24	203.0	94.7	84	257.4	120.0
45	40.8	19.0	05	95.2	44.4	65	149.5	69.7	25	203.9	95.1	85	258.3	120.4
46	41.7	19.4	06	96.1	44.8	66	150.4	70.2	26	204.8	95.5	86	259.2	120.9
47	42.6	19.9	07	97.0	45.2	67	151.4	70.6	27	205.7	95.9	87	260.1	121.3
48	43.5	20.3	08	97.9	45.6	68	152.3	71.0	28	206.6	96.4	88	261.0	121.7
49	44.4	20.7	09	98.8	46.1	69	153.2	71.4	29	207.5	96.8	89	261.9	122.1
50	45.3	21.1	10	99.7	46.5	70	154.1	71.8	30	208.4	97.2	90	262.8	122.6
51	46.2	21.6	111	100.6	46.9	71	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	12	101.5	47.3	72	155.9	72.7	32	210.3	98.0	92	264.6	123.4
53	48.0	22.4	13	102.4	47.8	73	156.8	73.1	33	211.2	98.5	93	265.5	123.8
54	48.9	22.8	14	103.3	48.2	74	157.7	73.5	34	212.1	98.9	94	266.5	124.2
55	49.8	23.2	15	104.2	48.6	75	158.6	74.0	35	213.0	99.5	95	267.4	124.7
56	50.8	23.7	16	105.1	49.0	76	159.5	74.4	36	213.9	99.7	96	268.3	125.1
57	51.7	24.1	17	106.0	49.4	77	160.4	74.8	37	214.8	100.2	97	269.2	125.5
58	52.7	24.5	18	106.9	49.9	78	161.3	75.2	38	215.7	100.6	98	270.1	125.9
59	53.5	24.9	19	107.8	50.3	79	162.2	75.6	39	216.6	101.0	99	271.0	126.4
60	54.4	25.4	20	108.8	50.7	80	163.1	76.1	40	217.2	101.4	300	271.9	126.8
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

Difference of Latitude and Departure for 26 Degrees.

D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.
1	00.9	00.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.4	241	216.6	105.7
2	01.8	00.9	62	55.7	27.2	22	109.7	53.5	82	163.6	79.8	42	217.5	106.1
3	02.7	01.3	63	56.6	27.6	23	110.6	53.9	83	164.5	80.2	43	218.4	106.5
4	03.6	01.8	64	57.5	28.1	24	111.5	54.4	84	165.4	80.7	44	219.3	107.0
5	04.5	02.2	65	58.4	28.5	25	112.4	54.8	85	166.3	81.1	45	220.2	107.4
6	05.4	02.6	66	59.3	28.9	26	113.2	55.2	86	167.2	81.5	46	221.1	107.8
7	06.3	03.1	67	60.2	29.4	27	114.1	55.7	87	168.1	82.0	47	222.0	108.3
8	07.2	03.5	68	61.1	29.8	28	115.0	56.1	88	169.0	82.4	48	222.9	108.7
9	08.1	03.9	69	62.0	30.2	29	115.9	56.6	89	169.9	82.9	49	223.8	109.2
10	09.0	04.4	70	62.9	30.7	30	116.8	57.0	90	170.8	83.3	50	224.7	109.6
11	09.9	04.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	05.3	72	64.7	31.6	32	118.6	57.9	02	172.6	84.2	52	226.5	110.5
13	11.7	05.7	73	65.6	32.0	33	119.5	58.3	03	173.5	84.6	53	227.4	110.9
14	12.6	06.1	74	66.5	32.4	34	120.4	58.7	04	174.4	85.0	54	228.3	111.4
15	13.5	06.6	75	67.4	32.9	35	121.3	59.2	05	175.3	85.5	55	229.2	111.8
16	14.4	07.0	76	68.3	33.3	36	122.2	59.6	06	176.2	85.9	56	230.1	112.2
17	15.3	07.5	77	69.2	33.8	37	123.1	60.1	07	177.1	86.4	57	231.0	112.7
18	16.2	07.9	78	70.1	34.2	38	124.0	60.5	08	178.0	86.8	58	231.9	113.1
19	17.1	08.3	79	71.0	34.6	39	124.9	60.9	09	178.9	87.2	59	232.8	113.5
20	18.0	08.7	80	71.9	35.1	40	125.8	61.4	200	179.8	87.7	60	233.7	114.0
21	18.9	09.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	09.6	82	73.7	35.9	42	127.6	62.3	02	181.6	88.6	62	235.5	114.9
23	20.7	10.1	83	74.6	36.4	43	128.5	62.7	03	182.5	89.0	63	236.4	115.3
24	21.6	10.5	84	75.5	36.8	44	129.4	63.1	04	183.4	89.4	64	237.3	115.7
25	22.5	11.0	85	76.4	37.3	45	130.3	63.6	05	184.3	89.9	65	238.2	116.2
26	23.4	11.4	86	77.3	37.7	46	131.2	64.0	06	185.2	90.3	66	239.1	116.6
27	24.3	11.8	87	78.2	38.1	47	132.1	64.4	07	186.1	90.7	67	240.0	117.1
28	25.2	12.3	88	79.1	38.6	48	133.0	64.9	08	187.0	91.2	68	240.9	117.5
29	26.1	12.7	89	80.0	39.0	49	133.9	65.3	09	187.8	91.6	69	241.8	117.9
30	27.0	13.2	90	80.9	39.5	50	134.8	65.8	10	188.7	92.1	70	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	52	136.6	66.6	12	190.5	92.9	72	244.5	119.2
33	29.7	14.5	93	83.6	40.8	53	137.5	67.1	13	191.4	93.4	73	245.4	119.7
34	30.6	14.9	94	84.5	41.2	54	138.4	67.5	14	192.3	93.8	74	246.3	120.1
35	31.5	15.3	95	85.4	41.6	55	139.3	68.0	15	193.2	94.3	75	247.2	120.6
36	32.4	15.8	96	86.3	42.1	56	140.2	68.4	16	194.1	94.7	76	248.1	121.0
37	33.3	16.2	97	87.2	42.5	57	141.1	68.8	17	195.0	95.1	77	249.0	121.4
38	34.2	16.7	98	88.1	43.0	58	142.0	69.3	18	195.9	95.6	78	249.9	121.9
39	35.1	17.1	99	89.0	43.4	59	142.9	69.7	19	196.8	96.0	79	250.8	122.3
40	36.0	17.5	100	89.9	43.8	60	143.8	70.1	20	197.7	96.4	80	251.7	122.8
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	02	91.7	44.7	62	145.6	71.0	22	199.5	97.3	82	253.5	123.6
43	38.6	18.9	03	92.6	45.2	63	146.5	71.5	23	200.4	97.8	83	254.4	124.1
44	39.5	19.3	04	93.5	45.6	64	147.4	71.9	24	201.3	98.2	84	255.3	124.5
45	40.4	19.7	05	94.4	46.0	65	148.3	72.3	25	202.2	98.6	85	256.2	124.9
46	41.3	20.2	06	95.3	46.5	66	149.2	72.8	26	203.1	99.1	86	257.1	125.4
47	42.2	20.6	07	96.2	46.9	67	150.1	73.2	27	204.0	99.5	87	258.0	125.8
48	43.1	21.0	08	97.1	47.3	68	151.0	73.7	28	204.9	100.0	88	258.9	126.3
49	44.0	21.5	09	98.0	47.8	69	151.9	74.1	29	205.8	100.4	89	259.8	126.7
50	44.9	21.9	10	98.9	48.2	70	152.8	74.5	30	206.7	100.8	90	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.6	127.6
52	46.7	22.8	12	100.7	49.1	72	154.6	75.4	32	208.5	101.7	92	262.4	128.0
53	47.6	23.2	13	101.6	49.5	73	155.5	75.8	33	209.4	102.1	93	263.3	128.5
54	48.5	23.7	14	102.5	50.0	74	156.4	76.3	34	210.3	102.6	94	264.2	128.9
55	49.4	24.1	15	103.4	50.4	75	157.3	76.7	35	211.2	103.0	95	265.1	129.3
56	50.3	24.6	16	104.3	50.9	76	158.2	77.2	36	212.1	103.5	96	266.0	129.8
57	51.2	25.0	17	105.2	51.3	77	159.1	77.6	37	213.0	103.9	97	266.9	130.2
58	52.1	25.4	18	106.1	51.7	78	160.0	78.0	38	213.9	104.3	98	267.8	130.6
59	53.0	25.9	19	107.0	52.2	79	160.9	78.5	39	214.8	104.8	99	268.7	131.1
60	53.9	26.3	20	107.9	52.6	80	161.8	78.9	40	215.7	105.2	300	269.6	131.5
D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.	D. It	Lat.	Dep.

for 64 Degrees.

Difference of Latitude and Departure for 27 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	122	108.7	55.4	182	162.2	82.6	242	215.6	109.9
3	02.7	01.4	63	56.1	28.6	123	109.6	55.8	183	163.1	83.1	243	216.5	110.3
4	03.6	01.8	64	57.0	29.1	124	110.5	56.3	184	163.9	83.5	244	217.4	110.8
5	04.5	02.3	65	57.9	29.5	125	111.4	56.8	185	164.8	84.0	245	218.3	111.2
6	05.3	02.7	66	58.8	30.0	126	112.3	57.2	186	165.7	84.4	246	219.2	111.7
7	06.2	03.2	67	59.7	30.4	127	113.2	57.7	187	166.6	84.9	247	220.1	112.1
8	07.1	03.6	68	60.6	30.9	128	114.0	58.1	188	167.5	85.4	248	221.0	112.6
9	08.0	04.1	69	61.5	31.3	129	114.9	58.6	189	168.4	85.8	249	221.9	113.0
10	08.9	04.5	70	62.4	31.8	130	115.8	59.0	190	169.3	86.3	250	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	132	117.6	59.9	192	171.1	87.2	252	224.5	114.4
13	11.6	05.9	73	65.0	33.1	133	118.5	60.4	193	172.0	87.6	253	225.4	114.9
14	12.5	06.4	74	65.9	33.6	134	119.4	60.8	194	172.9	88.1	254	226.3	115.3
15	13.4	06.8	75	66.8	34.1	135	120.3	61.3	195	173.7	88.5	255	227.2	115.8
16	14.3	07.3	76	67.7	34.5	136	121.2	61.7	196	174.6	89.0	256	228.1	116.2
17	15.1	07.7	77	68.6	35.0	137	122.1	62.2	197	175.5	89.4	257	229.0	116.7
18	16.0	08.2	78	69.5	35.4	138	123.0	62.7	198	176.4	89.9	258	229.9	117.1
19	16.9	08.6	79	70.4	35.9	139	123.8	63.1	199	177.3	90.3	259	230.8	117.6
20	17.8	09.1	80	71.3	36.3	140	124.7	63.6	200	178.2	90.8	260	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	142	126.5	64.5	202	180.0	91.7	262	233.4	118.9
23	20.5	10.4	83	74.0	37.7	143	127.4	64.9	203	180.9	92.2	263	234.3	119.4
24	21.4	10.9	84	74.8	38.1	144	128.3	65.4	204	181.8	92.6	264	235.2	119.9
25	22.3	11.4	85	75.7	38.6	145	129.2	65.8	205	182.7	93.1	265	236.1	120.3
26	23.2	11.8	86	76.6	39.0	146	130.1	66.3	206	183.5	93.5	266	237.0	120.8
27	24.1	12.3	87	77.5	39.5	147	131.0	66.7	207	184.4	94.0	267	237.9	121.2
28	24.9	12.7	88	78.4	40.0	148	131.9	67.2	208	185.3	94.4	268	238.8	121.7
29	25.8	13.2	89	79.3	40.4	149	132.8	67.6	209	186.2	94.9	269	239.7	122.1
30	26.7	13.6	90	80.2	40.9	150	133.7	68.1	210	187.1	95.3	270	240.6	122.6
31	27.0	14.1	91	81.1	41.3	151	134.5	68.0	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	152	135.4	69.0	212	188.9	96.2	272	242.4	123.5
33	29.4	15.0	93	82.9	42.2	153	136.3	69.5	213	189.8	96.7	273	243.2	123.9
34	30.3	15.4	94	83.8	42.7	154	137.2	69.9	214	190.7	97.2	274	244.1	124.4
35	31.2	15.9	95	84.6	43.1	155	138.1	70.4	215	191.6	97.6	275	245.0	124.9
36	32.1	16.3	96	85.5	43.6	156	139.0	70.8	216	192.5	98.1	276	245.9	125.3
37	33.0	16.8	97	86.4	44.0	157	139.9	71.3	217	193.3	98.5	277	246.8	125.8
38	33.9	17.3	98	87.3	44.5	158	140.8	71.7	218	194.2	99.0	278	247.7	126.2
39	34.7	17.7	99	88.2	44.9	159	141.7	72.2	219	195.1	99.4	279	248.6	126.7
40	35.6	18.2	100	89.1	45.4	160	142.6	72.6	220	196.0	99.9	280	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	102	90.9	46.3	162	144.3	73.5	222	197.8	100.8	282	251.3	128.0
43	38.3	19.5	103	91.8	46.8	163	145.2	74.0	223	198.7	101.2	283	252.2	128.5
44	39.2	20.0	104	92.7	47.2	164	146.1	74.5	224	199.6	101.7	284	253.0	128.9
45	40.1	20.4	105	93.6	47.7	165	147.0	74.9	225	200.5	102.2	285	253.9	129.4
46	41.0	20.9	106	94.4	48.1	166	147.9	75.4	226	201.4	102.6	286	254.8	129.8
47	41.9	21.3	107	95.3	48.6	167	148.8	75.8	227	202.3	103.1	287	255.7	130.3
48	42.8	21.8	108	96.2	49.0	168	149.7	76.3	228	203.1	103.5	288	256.6	130.8
49	43.7	22.2	109	97.1	49.5	169	150.6	76.7	229	204.0	104.0	289	257.5	131.2
50	44.6	22.7	110	98.0	49.9	170	151.5	77.2	230	204.9	104.4	290	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.0	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	112	99.8	50.8	172	153.3	78.1	232	206.7	105.3	292	260.2	132.6
53	47.2	24.1	113	100.7	51.3	173	154.1	78.5	233	207.6	105.8	293	261.1	133.0
54	48.1	24.5	114	101.6	51.8	174	155.0	79.0	234	208.5	106.2	294	262.0	133.5
55	49.0	25.0	115	102.5	52.2	175	155.9	79.5	235	209.4	106.7	295	262.8	133.9
56	49.9	25.4	116	103.4	52.7	176	156.8	79.9	236	210.3	107.1	296	263.7	134.4
57	50.8	25.9	117	104.2	53.1	177	157.7	80.4	237	211.2	107.6	297	264.6	134.8
58	51.7	26.3	118	105.1	53.6	178	158.6	80.8	238	212.1	108.1	298	265.5	135.3
59	52.6	26.8	119	106.0	54.0	179	159.5	81.3	239	212.9	108.5	299	266.4	135.7
60	53.5	27.2	120	106.9	54.5	180	160.4	81.7	240	213.8	109.0	300	267.3	136.2
Diff	Dep	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

Difference of Latitude and Departure for 28 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
2	01.8	00.9	62	54.7	29.1	122	107.7	57.3	182	160.7	85.4	242	213.7	113.6
3	02.6	01.4	63	55.6	29.6	123	108.6	57.7	183	161.6	85.9	243	214.6	114.1
4	03.5	01.9	64	56.5	30.0	124	109.5	58.2	184	162.5	86.4	244	215.5	114.6
5	04.4	02.3	65	57.4	30.5	125	110.4	58.7	185	163.4	86.9	245	216.3	115.0
6	05.3	02.8	66	58.3	31.0	126	111.3	59.2	186	164.2	87.3	246	217.2	115.5
7	06.2	03.3	67	59.2	31.5	127	112.1	59.6	187	165.1	87.8	247	218.1	115.9
8	07.1	03.8	68	60.0	31.9	128	113.0	60.1	188	166.0	88.3	248	219.0	116.4
9	07.9	04.3	69	60.9	32.4	129	113.9	60.6	189	166.9	88.7	249	219.9	116.9
10	08.8	04.7	70	61.8	32.9	130	114.8	61.0	190	167.8	89.2	250	220.8	117.4
11	09.7	05.2	71	62.7	33.3	131	115.7	61.5	191	168.7	89.7	251	221.6	117.8
12	10.6	05.6	72	63.6	33.8	132	116.6	62.0	192	169.5	90.1	252	222.5	118.3
13	11.5	06.1	73	64.5	34.3	133	117.4	62.4	193	170.4	90.6	253	223.4	118.8
14	12.4	06.6	74	65.3	34.7	134	118.3	62.9	194	171.3	91.1	254	224.3	119.2
15	13.2	07.0	75	66.2	35.2	135	119.2	63.4	195	172.2	91.6	255	225.2	119.7
16	14.1	07.5	76	67.1	35.7	136	120.1	63.9	196	173.1	92.0	256	226.0	120.2
17	15.0	08.0	77	68.0	36.2	137	121.0	64.3	197	174.0	92.5	257	226.9	120.7
18	16.9	08.5	78	68.9	36.6	138	121.9	64.8	198	174.8	93.0	258	227.8	121.1
19	17.8	08.9	79	69.8	37.1	139	122.7	65.3	199	175.7	93.4	259	228.7	121.6
20	18.7	09.4	80	70.6	37.6	140	123.6	65.7	200	176.6	93.9	260	229.6	122.1
21	18.5	09.9	81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.5	122.5
22	19.4	10.3	82	72.4	38.5	142	125.4	66.7	202	178.4	94.8	262	231.3	123.0
23	20.3	10.8	83	73.3	39.0	143	126.3	67.1	203	179.2	95.3	263	232.2	123.5
24	21.2	11.3	84	74.2	39.4	144	127.2	67.6	204	180.1	95.8	264	233.1	123.9
25	22.1	11.7	85	75.1	39.9	145	128.0	68.1	205	181.0	96.2	265	234.0	124.4
26	23.0	12.2	86	75.9	40.4	146	128.9	68.5	206	181.9	96.7	266	234.9	124.9
27	23.8	12.7	87	76.8	40.8	147	129.8	69.0	207	182.8	97.2	267	235.8	125.4
28	24.7	13.1	88	77.7	41.3	148	130.7	69.5	208	183.7	97.7	268	236.6	125.8
29	25.6	13.6	89	78.6	41.8	149	131.6	70.0	209	184.5	98.1	269	237.5	126.3
30	26.5	14.1	90	79.5	42.3	150	132.5	70.4	210	185.4	98.6	270	238.4	126.8
31	27.4	14.6	91	80.4	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.3
32	28.3	15.0	92	81.2	43.2	152	134.2	71.4	212	187.2	99.5	272	240.2	127.7
33	29.1	15.5	93	82.1	43.7	153	135.1	71.8	213	188.1	100.0	273	241.1	128.2
34	30.0	16.0	94	83.0	44.1	154	136.0	72.3	214	189.0	100.5	274	241.9	128.6
35	30.9	16.4	95	83.9	44.6	155	136.9	72.8	215	189.8	100.9	275	242.8	129.1
36	31.8	16.9	96	84.8	45.1	156	137.7	73.2	216	190.7	101.4	276	243.7	129.6
37	32.7	17.4	97	85.7	45.5	157	138.6	73.7	217	191.6	101.9	277	244.6	130.1
38	33.6	17.8	98	86.5	46.0	158	139.5	74.2	218	192.5	102.4	278	245.5	130.5
39	34.5	18.3	99	87.4	46.5	159	140.4	74.6	219	193.4	102.8	279	246.4	131.0
40	35.3	18.8	100	88.3	47.0	160	141.3	75.1	220	194.3	103.3	280	247.2	131.5
41	36.2	19.2	101	89.2	47.4	161	142.2	75.6	221	195.1	103.8	281	248.1	131.9
42	37.1	19.7	102	90.1	47.9	162	143.0	76.1	222	196.0	104.2	282	249.0	132.4
43	38.0	20.2	103	90.9	48.4	163	143.9	76.5	223	196.9	104.7	283	249.9	132.9
44	38.9	20.7	104	91.8	48.8	164	144.8	77.0	224	197.8	105.2	284	250.8	133.3
45	39.7	21.1	105	92.7	49.3	165	145.7	77.5	225	198.7	105.6	285	251.7	133.8
46	40.6	21.6	106	93.6	49.8	166	146.6	77.9	226	199.6	106.1	286	252.5	134.3
47	41.5	22.1	107	94.5	50.2	167	147.5	78.4	227	200.4	106.6	287	253.4	134.7
48	42.4	22.5	108	95.4	50.7	168	148.3	78.9	228	201.3	107.0	288	254.3	135.2
49	43.3	23.0	109	96.2	51.2	169	149.2	79.3	229	202.2	107.5	289	255.2	135.7
50	44.2	23.5	110	97.1	51.6	170	150.1	79.8	230	203.1	108.4	290	256.1	136.1
51	45.0	23.9	111	98.0	52.1	171	151.0	80.3	231	204.0	108.5	291	257.0	136.6
52	45.9	24.4	112	98.9	52.6	172	151.9	80.8	232	204.9	108.9	292	257.8	137.1
53	46.8	24.9	113	99.8	53.1	173	152.8	81.2	233	205.7	109.4	293	258.7	137.6
54	47.7	25.4	114	100.7	53.5	174	153.6	81.7	234	206.6	109.9	294	259.0	138.0
55	48.6	25.8	115	101.5	54.0	175	154.5	82.2	235	207.5	110.3	295	260.5	138.5
56	49.4	26.3	116	102.4	54.5	176	155.4	82.6	236	208.4	110.8	296	261.4	139.0
57	50.3	26.8	117	103.3	54.9	177	156.3	83.1	237	209.3	111.3	297	262.3	139.4
58	51.2	27.2	118	104.2	55.4	178	157.2	83.6	238	210.2	111.7	298	263.1	139.9
59	52.1	27.7	119	105.1	55.9	179	158.1	84.0	239	211.0	112.2	299	264.0	140.4
60	53.0	28.2	120	106.0	56.3	180	158.9	84.5	240	211.9	112.7	300	264.9	140.9
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 62 Degrees

Difference of Latitude and Departure for 29 Degrees.

Dift	Lat	Dep.	Dift	Lat	Dep.	Dift	Lat	Dep.	Dift	Lat	Dep.	Dift	Lat	Dep.
1	01.9	00.5	61	53.4	29.6	121	105.8	53.7	181	158.3	87.7	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	22	106.7	59.1	82	159.2	88.2	42	211.7	117.3
3	02.6	01.5	63	55.1	30.5	23	107.6	59.6	83	160.1	88.7	43	212.5	117.8
4	03.5	01.9	64	56.0	31.0	24	108.5	60.1	84	160.9	89.2	44	213.4	118.3
5	04.4	02.4	65	56.8	31.5	25	109.3	60.6	85	161.8	89.7	45	214.3	118.8
6	05.2	02.9	66	57.7	32.0	26	110.2	61.1	86	162.7	90.2	46	215.2	119.3
7	06.1	03.4	67	58.6	32.5	27	111.1	61.6	87	163.6	90.7	47	216.0	119.7
8	07.0	03.9	68	59.5	33.0	28	111.9	62.1	88	164.4	91.1	48	216.9	120.2
9	07.9	04.4	69	60.3	33.5	29	112.8	62.5	89	165.3	91.6	49	217.9	120.7
10	08.7	04.8	70	61.2	33.9	30	113.7	63.0	90	166.2	92.1	50	218.7	121.2
11	09.6	05.3	71	62.1	34.4	31	114.6	63.5	191	167.0	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	32	115.4	64.0	92	167.9	93.1	52	220.4	122.2
13	11.4	06.3	73	63.8	35.4	33	116.3	64.5	93	168.8	93.6	53	221.3	122.7
14	12.2	06.8	74	64.7	35.9	34	117.2	65.0	94	169.7	94.1	54	222.2	123.1
15	13.1	07.3	75	65.6	36.4	35	118.1	65.4	95	170.5	94.5	55	223.0	123.6
16	14.0	07.8	76	66.5	36.8	36	118.9	65.9	96	171.4	95.0	56	223.9	124.1
17	14.9	08.2	77	67.3	37.3	37	119.8	66.4	97	172.3	95.5	57	224.8	124.6
18	15.7	08.7	78	68.2	37.8	38	120.7	66.9	98	173.2	96.0	58	225.6	125.1
19	16.6	09.2	79	69.1	38.3	39	121.6	67.4	99	174.0	96.5	59	226.5	125.6
20	17.5	09.7	80	70.0	38.8	40	122.4	67.9	200	174.9	97.0	60	227.4	126.0
21	18.4	10.2	81	70.8	39.3	41	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	42	124.2	68.9	02	176.7	97.9	62	229.1	127.0
23	20.1	11.2	83	72.6	40.2	43	125.1	69.3	03	177.5	98.4	63	230.0	127.5
24	21.0	11.6	84	73.5	40.7	44	125.9	69.8	04	178.4	98.9	64	230.9	128.0
25	21.9	12.1	85	74.3	41.2	45	126.8	70.3	05	179.3	99.4	65	231.8	128.5
26	22.7	12.6	86	75.2	41.7	46	127.7	70.8	06	180.2	99.9	66	232.6	129.0
27	23.6	13.1	87	76.1	42.2	47	128.6	71.3	07	181.0	100.4	67	233.5	129.4
28	24.5	13.6	88	77.0	42.7	48	129.4	71.8	08	181.9	100.8	68	234.4	129.9
29	25.4	14.1	89	77.8	43.1	49	130.3	72.2	09	182.8	101.4	69	235.3	130.4
30	26.2	14.5	90	78.7	43.6	50	131.2	72.7	10	183.7	101.8	70	236.1	130.9
31	27.1	15.0	91	79.6	44.1	51	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	52	132.9	73.7	12	185.4	102.8	72	237.9	131.9
33	28.9	16.0	93	81.3	45.1	53	133.8	74.2	13	186.3	103.3	73	238.8	132.4
34	29.7	16.5	94	82.2	45.6	54	134.7	74.7	14	187.2	103.7	74	239.6	132.8
35	30.6	17.0	95	83.1	46.1	55	135.6	75.1	15	188.0	104.2	75	240.5	133.3
36	31.5	17.5	96	84.0	46.5	56	136.4	75.6	16	188.9	104.7	76	241.4	133.8
37	32.4	17.9	97	84.8	47.0	57	137.3	76.1	17	189.8	105.2	77	242.3	134.3
38	33.2	18.4	98	85.7	47.5	58	138.2	76.6	18	190.7	105.7	78	243.1	134.8
39	34.1	18.9	99	86.6	48.0	59	139.1	77.1	19	191.5	106.2	79	244.0	135.3
40	35.0	19.4	100	87.5	48.5	60	139.9	77.6	20	192.4	106.7	80	244.9	135.7
41	35.9	19.9	101	88.3	49.0	61	140.8	78.1	221	193.3	107.1	221	245.8	136.2
42	36.7	20.4	02	89.2	49.4	62	141.7	78.5	22	194.2	107.6	82	246.6	136.7
43	37.6	20.8	03	90.1	49.9	63	142.6	79.0	23	195.0	108.1	83	247.5	137.2
44	38.5	21.3	04	91.0	50.4	64	143.4	79.5	24	195.9	108.6	84	248.4	137.7
45	39.4	21.8	05	91.8	50.9	65	144.3	80.0	25	196.8	109.1	85	249.3	138.2
46	40.2	22.3	06	92.7	51.4	66	145.2	80.5	26	197.7	109.6	86	250.1	138.7
47	41.1	22.8	07	93.6	51.9	67	146.1	81.0	27	198.5	110.0	87	251.0	139.1
48	42.0	23.3	08	94.5	52.4	68	146.9	81.4	28	199.4	110.5	88	251.9	139.6
49	42.9	23.8	09	95.3	52.8	69	147.8	81.9	29	200.3	111.0	89	252.8	140.1
50	43.7	24.2	10	96.2	53.3	70	148.7	82.4	30	201.2	111.5	90	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	12	98.0	54.3	72	150.4	83.4	32	202.9	112.5	92	255.4	141.6
53	46.4	25.7	13	98.8	54.8	73	151.3	83.9	33	203.8	113.0	93	256.3	142.0
54	47.2	26.2	14	99.7	55.3	74	152.2	84.4	34	204.7	113.4	94	257.1	142.5
55	48.1	26.7	15	100.6	55.8	75	153.1	84.8	35	205.5	113.9	95	258.0	143.0
56	49.0	27.1	16	101.5	56.2	76	153.9	85.3	36	206.4	114.4	96	258.9	143.5
57	49.9	27.6	17	102.3	56.7	77	154.8	85.8	37	207.3	114.9	97	259.8	144.0
58	50.7	28.1	18	103.2	57.2	78	155.7	86.3	38	208.2	115.4	98	260.6	144.5
59	51.6	28.6	19	104.1	57.7	79	156.6	86.8	39	209.0	115.9	99	261.5	145.0
60	52.5	29.1	20	105.0	58.2	80	157.4	87.3	40	209.9	116.4	300	262.4	145.4
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 61 Degrees.

Difference of Latitude and Departure for 30 Degrees.

Difference of Latitude and Departure for 60 Degrees.														
Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.8	30.5	121	104.8	60.5	181	156.7	90.5	241	208.7	120.5
2	01.7	01.0	62	53.7	31.0	22	105.7	61.0	82	157.1	91.0	42	209.6	121.0
3	02.6	01.5	63	54.6	31.5	23	106.5	61.5	83	158.0	91.5	43	210.4	121.5
4	03.5	02.0	64	55.4	32.0	24	107.4	62.0	84	159.0	92.0	44	211.3	122.0
5	04.3	02.5	65	56.3	32.5	25	108.3	62.5	85	160.0	92.5	45	212.2	122.5
6	05.2	03.0	66	57.2	33.0	26	109.1	63.0	86	161.1	93.0	46	213.0	123.0
7	06.1	03.5	67	58.0	33.5	27	110.0	63.5	87	161.9	93.5	47	213.9	123.5
8	06.9	04.0	68	58.9	34.0	28	110.8	64.0	88	162.8	94.0	48	214.8	124.0
9	07.8	04.5	69	59.8	34.5	29	111.7	64.5	89	163.7	94.5	49	215.6	124.5
10	08.7	05.0	70	60.6	35.0	30	112.6	65.0	90	164.6	95.0	50	216.5	125.0
11	09.5	05.5	71	61.5	35.5	131	113.4	65.5	191	165.4	95.5	251	217.4	125.5
12	10.4	06.0	72	62.4	36.0	32	114.3	66.0	92	166.1	96.0	52	218.3	126.0
13	11.3	06.5	73	63.2	36.5	33	115.2	66.5	93	167.1	96.5	53	219.1	126.5
14	12.1	07.0	74	64.1	37.0	34	116.1	67.0	94	168.0	97.0	54	220.0	127.0
15	13.0	07.5	75	65.0	37.5	35	116.9	67.5	95	168.8	97.5	55	220.8	127.5
16	13.9	08.0	76	65.8	38.0	36	117.8	68.0	96	169.7	98.0	56	221.7	128.0
17	14.7	08.5	77	66.7	38.5	37	118.6	68.5	97	170.6	98.5	57	222.6	128.5
18	15.6	09.0	78	67.5	39.0	38	119.5	69.0	98	171.5	99.0	58	223.4	129.0
19	16.5	09.5	79	68.4	39.5	39	120.4	69.5	99	172.4	99.5	59	224.3	129.5
20	17.3	10.0	80	69.3	40.0	40	121.2	70.0	200	173.2	100.0	60	225.1	130.0
21	18.2	10.5	81	70.1	40.5	141	122.1	70.5	201	174.1	100.5	201	226.0	130.5
22	19.1	11.0	82	71.0	41.0	42	123.0	71.0	2	174.9	101.0	62	226.9	131.0
23	19.9	11.5	83	71.9	41.5	43	123.8	71.5	03	175.8	101.5	63	227.8	131.5
24	20.8	12.0	84	72.7	42.0	44	124.7	72.0	04	176.7	102.0	64	228.6	132.0
25	21.7	12.5	85	73.6	42.5	45	125.6	72.5	05	177.6	102.5	65	229.5	132.5
26	22.5	13.0	86	74.5	43.0	46	126.4	73.0	06	178.4	103.0	66	230.4	133.0
27	23.4	13.5	87	75.3	43.5	47	127.3	73.5	07	179.3	103.5	67	231.2	133.5
28	24.2	14.0	88	76.2	44.0	48	128.2	74.0	08	180.1	104.0	68	232.1	134.0
29	25.1	14.5	89	77.1	44.5	49	129.0	74.5	09	181.0	104.5	69	233.0	134.5
30	26.0	15.0	90	77.9	45.0	50	129.9	75.0	10	181.9	105.0	70	233.8	135.0
31	26.8	15.5	91	78.8	45.5	1	130.8	75.5	211	182.7	105.5	271	234.7	135.5
32	27.7	16.0	92	79.7	46.0	52	131.7	76.0	12	183.6	106.0	72	235.6	136.0
33	28.6	16.5	93	80.5	46.5	53	132.5	76.5	13	184.5	106.5	73	236.4	136.5
34	29.4	17.0	94	81.4	47.0	54	133.4	77.0	14	185.3	107.0	74	237.3	137.0
35	30.3	17.5	95	82.3	47.5	55	134.2	77.5	15	186.2	107.5	75	238.2	137.5
36	31.2	18.0	96	83.1	48.0	56	135.1	78.0	16	187.1	108.0	76	239.0	138.0
37	32.0	18.5	97	84.0	48.5	57	136.0	78.5	17	187.9	108.5	77	239.9	138.5
38	32.9	19.0	98	84.9	49.0	58	136.8	79.0	18	188.8	109.0	78	240.7	139.0
39	33.8	19.5	99	85.7	49.5	59	137.7	79.5	19	189.7	109.5	79	241.6	139.5
40	34.6	20.0	100	86.6	50.0	60	138.6	80.0	20	190.5	110.0	80	242.5	140.0
41	35.5	20.5	101	87.5	50.5	161	139.4	80.5	221	191.4	110.5	281	243.3	140.5
42	36.4	21.0	02	88.3	51.0	62	140.3	81.0	22	192.3	111.0	82	244.2	141.0
43	37.2	21.5	03	89.2	51.5	63	141.2	81.5	23	193.1	111.5	83	245.1	141.5
44	38.1	22.0	04	90.1	52.0	64	142.0	82.0	24	194.0	112.0	84	245.9	142.0
45	39.0	22.5	05	90.9	52.5	65	142.9	82.5	25	194.9	112.5	85	246.8	142.5
46	39.8	23.0	06	91.8	53.0	66	143.8	83.0	26	195.7	113.0	86	247.7	143.0
47	40.7	23.5	07	92.7	53.5	67	144.6	83.5	27	196.6	113.5	87	248.5	143.5
48	41.5	24.0	08	93.5	54.0	68	145.5	84.0	28	197.4	114.0	88	249.4	144.0
49	42.4	24.5	09	94.4	54.5	69	146.4	84.5	29	198.3	114.5	89	250.3	144.5
50	43.3	25.0	10	95.3	55.0	70	147.2	85.0	30	199.2	115.0	90	251.1	145.0
51	44.2	25.5	111	96.1	55.5	171	148.1	85.5	231	200.0	115.5	291	252.0	145.5
52	45.0	26.0	12	97.0	56.0	72	149.0	86.0	32	200.9	116.0	92	252.9	146.0
53	45.9	26.5	13	97.9	56.5	73	149.8	86.5	33	201.8	116.5	93	253.7	146.5
54	46.8	27.0	14	98.7	57.0	74	150.7	87.0	34	202.6	117.0	94	254.6	147.0
55	47.6	27.5	15	99.6	57.5	75	151.6	87.5	35	203.5	117.5	95	255.5	147.5
56	48.5	28.0	16	100.5	58.0	76	152.4	88.0	36	204.4	118.0	96	256.3	148.0
57	49.4	28.5	17	101.3	58.5	77	153.3	88.5	37	205.2	118.5	97	257.2	148.5
58	50.2	29.0	18	102.2	59.0	78	154.1	89.0	38	206.1	119.0	98	258.1	149.0
59	51.1	29.5	19	103.1	59.5	79	155.0	89.5	39	207.0	119.5	99	258.9	149.5
60	52.0	30.0	20	103.9	60.0	80	155.9	90.0	40	207.8	120.0	300	259.8	150.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.
for 60 Degrees.														

for 60 Degrees.

Difference of Latitude and Departure for 31 Degrees

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.5	124.1
2	01.7	01.0	62	53.1	31.9	22	104.6	62.8	82	156.0	93.7	42	207.4	124.6
3	02.6	01.5	63	54.0	32.4	23	105.4	63.3	83	156.8	94.2	43	208.3	125.1
4	03.4	02.1	64	54.8	33.0	24	106.3	63.9	84	157.7	94.8	44	209.1	125.6
5	04.3	02.6	65	55.7	33.5	25	107.1	64.4	85	158.5	95.3	45	210.0	126.2
6	05.1	03.1	66	56.6	34.0	26	108.0	64.9	86	159.4	95.8	46	210.8	126.7
7	06.0	03.6	67	57.4	34.5	27	108.8	65.4	87	160.3	96.3	47	211.7	127.2
8	06.9	04.1	68	58.3	35.0	28	109.7	65.9	88	161.1	96.8	48	212.5	127.7
9	07.7	04.6	69	59.1	35.5	29	110.6	66.4	89	162.0	97.3	49	213.4	128.2
10	08.6	05.2	70	60.0	36.1	30	111.4	67.0	90	162.8	97.9	50	214.3	128.8
11	09.4	05.7	71	60.8	36.6	31	112.3	67.5	91	163.7	98.4	51	215.1	129.3
12	10.3	06.2	72	61.7	37.1	32	113.1	68.0	92	164.5	98.9	52	216.0	129.8
13	11.1	06.7	73	62.6	37.6	33	114.0	68.5	93	165.4	99.4	53	216.8	130.3
14	12.0	07.2	74	63.4	38.1	34	114.8	69.0	94	166.3	99.9	54	217.7	130.8
15	13.9	07.7	75	64.3	38.6	35	115.7	69.5	95	167.1	100.4	55	218.5	131.3
16	13.7	08.2	76	65.1	39.1	36	116.6	70.0	96	168.0	100.9	56	219.4	131.8
17	14.6	08.8	77	66.0	39.7	37	117.4	70.6	97	168.8	101.5	57	220.2	132.4
18	15.4	09.3	78	66.8	40.2	38	118.3	71.1	98	169.7	102.0	58	221.1	132.9
19	16.3	09.8	79	67.7	40.7	39	119.1	71.6	99	170.5	102.5	59	222.0	133.4
20	17.1	10.3	80	68.6	41.2	40	120.0	72.1	200	171.4	103.0	60	222.8	133.9
21	18.0	10.8	81	69.4	41.7	41	120.8	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	42	121.7	73.1	02	173.1	104.0	62	224.5	134.9
23	19.7	11.8	83	71.1	42.7	43	122.6	73.6	03	174.0	104.5	63	225.4	135.4
24	20.6	12.4	84	72.0	43.3	44	123.4	74.2	04	174.8	105.0	64	226.2	136.0
25	21.4	12.9	85	72.8	43.8	45	124.3	74.7	05	175.7	105.6	65	227.1	136.5
26	22.3	13.4	86	73.7	44.3	46	125.1	75.2	06	176.5	106.1	66	228.0	137.0
27	23.1	13.9	87	74.6	44.8	47	126.0	75.7	07	177.4	106.6	67	228.8	137.5
28	24.0	14.4	88	75.4	45.3	48	126.8	76.2	08	178.3	107.1	68	229.7	138.0
29	24.9	14.9	89	76.3	45.8	49	127.7	76.7	09	179.1	107.6	69	230.5	138.5
30	25.7	15.5	90	77.1	46.4	50	128.6	77.3	10	180.0	108.2	70	231.4	139.1
31	26.6	16.0	91	78.0	46.9	51	129.4	77.8	211	180.8	108.7	271	232.2	139.6
32	27.4	16.5	92	78.8	47.4	52	130.3	78.3	12	181.7	109.2	72	233.1	140.1
33	28.3	17.0	93	79.7	47.9	53	131.1	78.8	13	182.5	109.7	73	234.0	140.6
34	29.1	17.5	94	80.6	48.4	54	132.0	79.3	14	183.4	110.2	74	234.8	141.1
35	30.0	18.0	95	81.4	48.9	55	132.8	79.8	15	184.3	110.7	75	235.7	141.6
36	31.9	18.5	96	82.3	49.4	56	133.7	80.3	16	185.1	111.2	76	236.5	142.1
37	31.7	19.1	97	83.1	50.0	57	134.5	80.9	17	186.0	111.8	77	237.4	142.7
38	32.6	19.6	98	84.0	50.5	58	135.4	81.4	18	186.8	112.3	78	238.2	143.2
39	33.4	20.1	99	84.8	51.0	59	136.3	81.9	19	187.7	112.8	79	239.1	143.7
40	34.3	20.6	100	85.7	51.5	60	137.1	82.4	20	188.5	113.3	80	240.0	144.2
41	35.1	21.1	101	86.6	52.0	61	138.0	82.9	221	189.4	113.8	281	240.8	144.7
42	36.0	21.6	02	87.4	52.5	62	138.8	83.4	22	190.3	114.3	82	241.7	145.2
43	36.9	22.1	03	88.3	53.0	63	139.7	83.9	23	191.1	114.8	83	242.5	145.7
44	37.7	22.6	04	89.1	53.6	64	140.5	84.5	24	192.0	115.4	84	243.4	146.3
45	38.6	23.2	05	90.0	54.1	65	141.4	84.0	25	192.8	115.9	85	244.2	146.8
46	39.4	23.7	06	90.8	54.6	66	142.3	84.5	26	193.7	116.4	86	245.1	147.3
47	40.3	24.2	07	91.7	55.1	67	143.1	85.0	27	194.5	116.9	87	246.0	147.8
48	41.1	24.7	08	92.6	55.6	68	144.0	85.5	28	195.4	117.4	88	246.8	148.3
49	42.0	25.2	09	93.4	56.1	69	144.8	86.0	29	196.3	117.9	89	247.7	148.8
50	42.9	25.8	10	94.3	56.7	70	145.7	86.6	30	197.1	118.5	90	248.5	149.4
51	43.7	26.3	111	95.1	57.2	171	146.5	87.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	12	96.0	57.7	72	147.4	87.6	32	198.8	119.5	92	250.2	150.4
53	45.4	27.5	13	96.8	58.2	73	148.3	88.1	33	199.7	120.0	93	251.1	150.9
54	46.3	27.8	14	97.7	58.7	74	149.1	88.6	34	200.5	120.5	94	252.0	151.4
55	47.1	28.3	15	98.6	59.2	75	150.0	89.1	35	201.4	121.0	95	252.8	151.9
56	47.0	28.8	16	99.4	59.7	76	150.8	89.6	36	202.3	121.5	96	253.7	152.4
57	48.8	29.4	17	100.3	60.3	77	151.7	90.1	37	203.1	122.1	97	254.5	153.0
58	49.7	29.9	18	101.1	60.8	78	152.5	90.7	38	204.0	122.6	98	255.4	153.5
59	50.6	30.4	19	102.0	61.3	79	153.4	91.2	39	204.8	123.1	99	256.2	154.0
60	51.4	30.9	20	102.8	61.8	80	154.3	91.7	40	205.7	123.6	300	257.1	154.5
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 59 Degrees.

Difference of Latitude and Departure for 32 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.5	61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
2	01.7	01.1	62	52.6	32.9	122	103.5	64.7	82	154.3	96.5	42	205.2	128.3
3	02.5	01.6	63	53.4	33.4	23	104.3	65.2	83	155.2	97.0	43	206.0	128.8
4	03.4	02.1	64	54.3	33.9	24	105.2	65.7	84	156.0	97.5	44	206.9	129.3
5	04.2	02.6	65	55.1	34.5	25	106.0	66.3	85	156.9	98.1	45	207.8	129.9
6	05.1	03.2	66	56.0	35.0	26	106.8	66.8	86	157.7	98.6	46	208.6	130.4
7	05.9	03.7	67	56.8	35.5	27	107.7	67.3	87	158.6	99.1	47	209.5	130.9
8	07.8	04.2	68	57.7	36.0	28	108.5	67.8	88	159.4	99.6	48	210.3	131.4
9	07.6	04.8	69	58.5	36.6	29	109.4	68.4	89	160.3	100.2	49	211.2	132.0
10	08.5	05.3	70	59.4	37.1	30	110.2	68.9	90	161.1	100.7	50	212.0	132.5
11	09.3	05.8	71	60.2	37.6	131	111.1	69.4	191	162.0	101.2	251	212.8	133.0
12	10.2	06.4	72	61.1	38.2	32	111.9	70.0	92	162.8	101.8	52	213.7	133.6
13	11.0	06.9	73	61.9	38.7	33	112.8	70.5	93	163.7	102.3	53	214.5	134.1
14	11.9	07.4	74	62.8	39.2	34	113.6	71.0	94	164.5	102.8	54	215.4	134.6
15	12.7	08.0	75	63.6	39.8	35	114.5	71.6	95	165.4	103.4	55	216.2	135.2
16	13.6	08.5	76	64.4	40.3	36	115.3	72.1	96	166.2	103.9	56	217.1	135.7
17	14.4	09.0	77	65.3	40.8	37	116.2	72.6	97	167.1	104.4	57	217.9	136.2
18	15.3	09.5	78	66.1	41.3	38	117.0	73.1	98	167.9	104.9	58	218.8	136.7
19	16.1	10.1	79	67.0	41.9	39	117.9	73.7	99	168.8	105.5	59	219.6	137.3
20	17.0	10.6	80	67.8	42.4	40	118.8	74.2	200	169.6	106.0	60	220.5	137.8
21	17.8	11.1	81	68.7	42.9	141	119.6	74.7	201	170.4	106.5	261	221.3	138.3
22	18.7	11.7	82	69.5	43.5	42	120.4	75.3	02	171.3	107.1	62	222.2	138.9
23	19.5	12.2	83	70.4	44.0	43	121.3	75.8	03	172.1	107.6	63	223.0	139.4
24	20.4	12.7	84	71.2	44.5	44	122.1	76.3	04	173.0	108.1	64	223.9	139.9
25	21.2	13.3	85	72.1	45.1	45	123.0	76.9	05	173.8	108.7	65	224.7	140.5
26	22.0	13.8	86	72.9	45.6	46	123.8	77.4	06	174.7	109.2	66	225.6	141.0
27	22.9	14.3	87	73.8	46.2	47	124.7	77.9	07	175.5	109.7	67	226.4	141.5
28	23.7	14.8	88	74.6	46.6	48	125.5	78.4	08	176.4	110.2	68	227.3	142.0
29	24.6	15.4	89	75.5	47.2	49	126.4	79.0	09	177.2	110.8	69	228.1	142.6
30	25.4	15.9	90	76.3	47.7	50	127.2	79.5	10	178.1	111.3	70	229.0	143.1
31	26.3	16.4	91	77.2	48.2	151	128.0	80.0	211	178.9	111.8	271	230.8	143.6
32	27.1	17.0	92	78.0	48.8	52	128.9	80.6	12	179.8	112.4	72	230.7	144.2
33	28.0	17.5	93	78.9	49.3	53	129.7	81.1	13	180.5	112.9	73	231.5	144.7
34	28.8	18.0	94	79.7	49.8	54	130.6	81.6	14	181.5	113.4	74	232.4	145.2
35	29.7	18.6	95	80.6	50.4	55	131.4	82.2	15	182.3	114.0	75	233.2	145.8
36	30.5	19.1	96	81.4	50.9	56	132.3	82.7	16	183.2	114.5	76	234.0	146.3
37	31.4	19.6	97	82.3	51.4	57	133.1	83.2	17	184.0	115.0	77	234.9	146.8
38	32.2	20.1	98	83.1	51.9	58	134.0	83.7	18	184.9	115.5	78	235.7	147.3
39	33.1	20.7	99	84.0	52.5	59	134.8	84.3	19	185.7	116.1	79	236.6	147.9
40	33.9	21.2	100	84.8	53.0	60	135.7	84.8	20	186.6	116.6	80	237.4	148.4
41	34.8	21.7	101	85.6	53.5	161	136.5	85.3	221	187.4	117.1	281	238.3	148.9
42	35.6	22.3	02	86.5	54.1	62	137.4	85.9	22	188.3	117.7	82	239.1	149.5
43	36.5	22.8	03	87.3	54.6	63	138.2	86.4	23	189.1	118.2	83	240.0	150.0
44	37.3	23.3	04	88.2	55.1	64	139.1	86.9	24	190.0	118.7	84	240.8	150.5
45	38.2	23.9	05	89.0	55.7	65	139.9	87.5	25	190.8	119.3	85	241.7	151.1
46	39.0	24.4	06	89.9	56.2	66	140.8	88.0	26	191.6	119.8	86	242.5	151.6
47	39.9	24.9	07	90.7	56.7	67	141.6	88.5	27	192.5	120.3	87	243.4	152.1
48	40.7	25.4	08	91.6	57.2	68	142.5	89.0	28	193.3	120.8	88	244.2	152.6
49	41.6	26.0	09	92.4	57.8	69	143.5	89.6	29	194.2	121.4	89	245.1	153.2
50	42.4	26.5	10	93.3	58.3	70	144.2	90.1	30	195.0	121.9	90	245.9	153.7
51	43.2	27.0	111	94.1	58.8	171	145.0	90.6	231	195.9	122.4	291	246.8	154.2
52	44.1	27.6	12	95.0	59.4	72	145.9	91.2	32	196.7	123.0	92	247.6	154.8
53	44.9	28.1	13	95.8	59.9	73	146.7	91.7	33	197.6	123.5	93	248.5	155.3
54	45.8	28.6	14	96.7	60.0	74	147.6	92.2	34	198.4	124.0	94	249.3	155.8
55	46.6	29.2	15	97.5	61.0	75	148.4	92.8	35	199.3	124.6	95	250.2	156.4
56	47.5	29.7	16	98.4	61.5	76	149.2	93.3	36	200.1	125.1	96	251.0	156.9
57	48.3	30.2	17	99.2	62.0	77	150.1	93.8	37	201.0	125.6	97	251.9	157.4
58	49.2	30.7	18	100.1	62.5	78	150.9	94.3	38	201.8	126.1	98	252.7	157.9
59	50.0	31.3	19	100.9	63.1	79	151.8	94.9	39	202.7	126.7	99	253.6	158.5
60	50.9	31.8	20	101.8	63.6	80	152.6	95.4	40	203.5	127.2	300	254.4	159.0
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 58 Degrees.

Difference of Latitude and Departure ≈ 33 Degrees.

Lat. Dep. Diff.			Lat. Dep. Diff.			Lat. Dep. Diff.			Lat. Dep. Diff.			Lat. Dep. Diff.			Lat. Dep. Diff.		
00.8	00.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.2	301	252.4	181.5	
01.7	01.1	62	52.0	33.8	22	102.3	66.4	82	152.6	99.1	42	202.9	131.8	311	253.2	182.1	
02.5	01.6	63	52.8	34.3	23	103.1	67.0	83	153.5	99.7	43	203.8	132.3	321	254.0	182.7	
03.4	02.2	64	53.7	34.9	24	104.0	67.5	84	154.3	100.2	44	204.6	132.9	331	254.8	183.3	
04.2	02.7	65	54.5	35.4	25	104.8	68.1	85	155.1	100.8	45	205.5	133.4	341	255.6	183.9	
05.0	03.3	66	55.3	35.9	26	105.7	68.6	86	156.0	101.3	46	206.3	134.0	351	256.4	184.5	
05.9	03.8	67	56.2	36.5	27	106.5	69.2	87	156.8	101.8	47	207.1	134.5	361	257.2	185.1	
06.7	04.4	68	57.0	37.0	28	107.3	69.7	88	157.7	102.4	48	208.0	135.1	371	258.0	185.7	
07.5	04.9	69	57.9	37.6	29	108.2	70.3	89	158.5	102.9	49	208.8	135.6	381	258.8	186.3	
08.4	05.4	70	58.7	38.1	30	109.0	70.8	90	159.3	103.5	50	209.7	136.2	391	259.6	186.9	
09.2	06.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7	401	260.4	187.5	
10.1	06.5	72	60.4	39.2	32	110.7	71.9	92	161.0	104.6	52	211.3	137.2	411	261.2	188.1	
10.9	07.1	73	61.2	39.8	33	111.5	72.4	93	161.8	105.1	53	212.2	137.8	421	262.0	188.7	
11.7	07.6	74	62.1	40.3	34	112.4	73.0	94	162.7	105.7	54	213.0	138.3	431	262.8	189.3	
12.6	08.2	75	62.9	40.8	35	113.2	73.5	95	163.5	106.2	55	213.8	138.9	441	263.6	189.9	
13.4	08.7	76	63.7	41.4	36	114.0	74.1	96	164.4	106.7	56	214.7	139.4	451	264.4	190.5	
14.3	09.3	77	64.6	41.9	37	114.9	74.6	97	165.2	107.3	57	215.5	140.0	461	265.2	191.1	
15.1	09.8	78	65.4	42.5	38	115.7	75.2	98	166.0	107.8	58	216.4	140.5	471	266.0	191.7	
15.9	10.3	79	66.2	43.0	39	116.6	75.7	99	166.9	108.4	59	217.2	141.1	481	266.8	192.3	
16.8	10.9	80	67.1	43.6	40	117.4	76.2	200	167.7	108.9	60	218.0	141.6	491	267.6	192.9	
17.6	11.4	81	67.9	44.1	141	118.2	76.8	201	168.6	109.5	261	218.9	142.1	501	268.4	193.5	
18.4	12.0	82	68.8	44.7	42	119.1	77.3	02	169.4	110.0	62	219.7	142.7	511	269.2	194.1	
19.3	12.5	83	69.6	45.2	43	119.9	77.9	03	170.2	110.6	63	220.6	143.2	521	270.0	194.7	
20.1	13.1	84	70.4	45.7	44	120.8	78.4	04	171.1	111.1	64	221.4	143.8	531	270.8	195.3	
21.0	13.6	85	71.3	46.3	45	121.6	79.0	05	171.9	111.6	65	222.2	144.3	541	271.6	195.9	
21.8	14.2	86	72.1	46.8	46	122.4	79.5	06	172.8	112.2	66	223.1	144.9	551	272.4	196.5	
22.6	14.7	87	73.0	47.4	47	123.3	80.1	07	173.6	112.7	67	223.9	145.4	561	273.2	197.1	
23.5	15.2	88	73.8	47.9	48	124.1	80.6	08	174.4	113.3	68	224.7	146.0	571	274.0	197.7	
24.3	15.8	89	74.6	48.5	49	125.0	81.1	09	175.3	113.8	69	225.6	146.5	581	274.8	198.3	
25.2	16.3	90	75.5	49.0	50	125.8	81.7	10	176.1	114.4	70	226.4	147.1	591	275.6	198.9	
26.0	16.9	91	76.3	49.6	151	126.6	82.2	211	176.9	114.9	271	227.3	147.6	601	276.4	199.5	
26.8	17.4	92	77.2	50.1	52	127.5	82.8	12	177.8	115.5	72	228.1	148.1	611	277.2	200.1	
27.7	18.0	93	78.0	50.6	53	128.3	83.3	13	178.6	116.0	73	228.9	148.7	621	278.0	200.7	
28.5	18.5	94	78.8	51.2	54	129.1	83.9	14	179.5	116.5	74	229.8	149.2	631	278.8	201.3	
29.4	19.1	95	79.7	51.7	55	130.0	84.4	15	180.3	117.1	75	230.6	149.8	641	279.6	201.9	
30.2	19.6	96	80.5	52.3	56	130.8	85.0	16	181.1	117.6	76	231.5	150.3	651	280.4	202.5	
31.0	20.2	97	81.3	52.8	57	131.7	85.5	17	182.0	118.2	77	232.3	150.9	661	281.2	203.1	
31.9	20.7	98	82.2	53.4	58	132.5	86.0	18	182.8	118.7	78	233.1	151.4	671	282.0	203.7	
32.7	21.2	99	83.0	53.9	59	133.3	86.6	19	183.7	119.3	79	234.0	151.9	681	282.8	204.3	
33.5	21.8	100	83.9	54.5	60	134.2	87.1	20	184.5	119.8	80	234.8	152.5	691	283.6	204.9	
34.4	22.3	101	84.7	55.0	161	135.0	87.7	211	185.3	120.4	281	235.6	153.0	701	284.4	205.5	
35.2	22.9	02	85.5	55.5	62	135.9	88.2	22	186.2	120.9	82	236.5	153.6	711	285.2	206.1	
36.1	23.4	03	86.4	56.1	63	136.7	88.8	23	187.0	121.4	83	237.3	154.1	721	286.0	206.7	
36.9	23.9	04	87.2	56.6	64	137.5	89.3	24	187.8	122.0	84	238.2	154.7	731	286.8	207.3	
37.7	24.5	05	88.1	57.2	65	138.4	89.9	25	188.7	122.5	85	239.0	155.2	741	287.6	207.9	
38.6	25.1	06	88.9	57.7	66	139.2	90.4	26	189.5	123.1	86	239.8	155.8	751	288.4	208.5	
39.4	25.6	07	89.7	58.3	67	140.0	90.9	27	190.4	123.6	87	240.7	156.3	761	289.2	209.1	
40.3	26.1	08	90.6	58.8	68	140.9	91.5	28	191.2	124.2	88	241.5	156.8	771	290.0	209.7	
41.1	26.7	09	91.4	59.4	69	141.7	92.0	29	192.0	124.7	89	242.4	157.4	781	290.8	210.3	
41.9	27.2	10	92.2	59.9	70	142.6	92.6	30	192.9	125.3	90	243.2	157.9	791	291.6	210.9	
42.8	27.8	111	93.1	60.5	171	143.4	93.1	211	193.7	125.8	291	244.0	158.5	801	292.4	211.5	
43.6	28.3	12	93.9	61.0	72	144.2	93.7	32	194.6	126.3	92	244.9	159.0	811	293.2	212.1	
44.4	28.9	13	94.8	61.5	73	145.1	94.2	33	195.4	126.9	93	245.7	159.6	821	294.0	212.7	
45.3	29.4	14	95.6	62.1	74	145.9	94.8	34	196.2	127.4	94	246.5	160.1	831	294.8	213.3	
46.1	30.0	15	96.4	62.6	75	146.8	95.3	35	197.1	128.0	95	247.4	160.7	841	295.6	213.9	
47.0	30.5	16	97.3	63.2	76	147.6	95.8	36	197.9	128.5	96	248.2	161.2	851	296.4	214.5	
47.8	31.0	17	98.1	63.7	77	148.4	96.4	37	198.7	129.1	97	249.1	161.7	861	297.2	215.1	
48.6	31.6	18	99.0	64.3	78	149.3	96.9	38	199.6	129.6	98	249.9	162.3	871	298.0	215.7	
49.5	32.1	19	99.8	64.8	79	150.1	97.5	39	200.4	130.2	99	250.7	162.8	881	298.8	216.3	
50.3	32.7	20	100.6	65.4	80	150.9	98.0	40	201.3	130.7	300	251.6	163.4	891	299.6	216.9	
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

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for 57 Degrees.

Difference of Latitude and Departure for 34 Degrees.

D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.	D. ft.	Lat.	Dep.
1	00.8	00.6	61	50.6	34.1	121	100.3	67.7	181	150.0	101.2	241	199.8	134.8
2	01.7	01.1	62	51.4	34.7	22	101.1	68.2	82	150.9	101.8	42	200.6	135.3
3	02.5	01.7	63	52.2	35.2	23	102.0	68.8	83	151.7	102.3	43	201.4	135.9
4	03.3	02.2	64	53.1	35.8	24	102.8	69.3	84	152.5	102.9	44	202.3	136.4
5	04.1	02.8	65	53.9	36.3	25	103.6	69.9	85	153.4	103.5	45	203.1	137.0
6	05.0	03.4	66	54.7	36.9	26	104.5	70.5	86	154.2	104.0	46	203.9	137.6
7	05.8	03.9	67	55.5	37.5	27	105.3	71.0	87	155.0	104.6	47	204.8	138.1
8	06.6	04.5	68	56.4	38.0	28	106.1	71.6	88	155.9	105.1	48	205.6	138.7
9	07.5	05.0	69	57.2	38.6	29	106.9	72.1	89	156.7	105.7	49	206.4	139.2
10	08.3	05.6	70	58.0	39.1	30	107.8	72.7	90	157.5	106.2	50	207.3	139.8
11	09.1	06.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	51	208.1	140.4
12	09.9	06.7	72	59.7	40.3	32	109.4	73.8	92	159.2	107.4	52	208.9	140.9
13	10.8	07.3	73	60.5	40.8	33	110.3	74.4	93	160.0	107.9	53	209.7	141.5
14	11.6	07.8	74	61.3	41.4	34	111.1	74.9	94	160.8	108.5	54	210.6	142.0
15	12.4	08.4	75	62.2	41.9	35	111.9	75.5	95	161.7	109.0	55	211.4	142.6
16	13.3	08.9	76	63.0	42.5	36	112.7	76.1	96	162.5	109.6	56	212.2	143.2
17	14.1	09.5	77	63.8	43.1	37	113.6	76.6	97	163.3	110.2	57	213.1	143.7
18	14.9	10.1	78	64.7	43.6	38	114.4	77.2	98	164.1	110.7	58	213.9	144.3
19	15.8	10.6	79	65.5	44.2	39	115.2	77.7	99	165.0	111.3	59	214.7	144.8
20	16.6	11.2	80	66.3	44.7	40	116.1	78.3	200	165.8	111.8	60	215.5	145.4
21	17.4	11.7	81	67.1	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	146.0
22	18.2	12.3	82	68.0	45.9	42	117.7	79.4	02	167.5	113.0	62	217.2	146.5
23	19.1	12.9	83	68.8	46.4	43	118.5	80.0	03	168.3	113.5	63	218.0	147.1
24	19.9	13.4	84	69.6	47.0	44	119.4	80.5	04	169.1	114.1	64	218.9	147.6
25	20.7	14.0	85	70.5	47.5	45	120.2	81.1	05	169.9	114.6	65	219.7	148.2
26	21.6	14.5	86	71.3	48.1	46	121.0	81.6	06	170.8	115.2	66	220.5	148.7
27	22.4	15.1	87	72.1	48.7	47	121.9	82.2	07	171.6	115.8	67	221.3	149.3
28	23.2	15.7	88	73.0	49.2	48	122.7	82.8	08	172.4	116.3	68	222.2	149.9
29	24.0	16.2	89	73.8	49.8	49	123.5	83.3	09	173.3	116.9	69	223.0	150.4
30	24.9	16.8	90	74.6	50.3	50	124.4	83.9	10	174.1	117.4	70	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	52	126.0	85.0	12	175.7	118.6	72	225.5	152.1
33	27.4	18.5	93	77.1	52.0	53	126.8	85.6	13	176.6	119.1	73	226.3	152.7
34	28.2	19.0	94	77.9	52.6	54	127.7	86.1	14	177.4	119.7	74	227.1	153.2
35	29.0	19.6	95	78.8	53.1	55	128.5	86.7	15	178.2	120.2	75	228.0	153.8
36	29.8	20.1	96	79.6	53.7	56	129.3	87.2	16	179.1	120.8	76	228.8	154.3
37	30.7	20.7	97	80.4	54.2	57	130.2	87.8	17	179.9	121.3	77	229.6	154.9
38	31.5	21.2	98	81.2	54.8	58	131.0	88.4	18	180.7	121.9	78	230.5	155.5
39	32.3	21.8	99	82.1	55.4	59	131.8	88.9	19	181.6	122.5	79	231.3	156.0
40	33.2	22.4	100	82.9	55.9	60	132.6	89.5	20	182.4	123.0	80	232.1	156.6
41	34.0	22.9	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	232.9	157.1
42	34.8	23.5	02	84.6	57.0	62	134.3	90.6	22	184.0	124.1	82	233.8	157.7
43	35.6	24.0	03	85.4	57.6	63	135.1	91.1	23	184.9	124.7	83	234.6	158.3
44	36.5	24.6	04	86.2	58.2	64	136.0	91.7	24	185.7	125.3	84	235.4	158.8
45	37.3	25.2	05	87.0	58.7	65	136.8	92.3	25	186.5	125.8	85	236.3	159.4
46	38.1	25.7	06	87.9	59.3	66	137.6	92.8	26	187.4	126.4	86	237.1	159.9
47	39.0	26.3	07	88.7	59.8	67	138.4	93.4	27	188.2	126.9	87	237.9	160.5
48	39.8	26.8	08	89.5	60.4	68	139.3	93.9	28	189.0	127.5	88	238.8	161.0
49	40.6	27.4	09	90.4	61.0	69	140.1	94.5	29	189.8	128.1	89	239.6	161.6
50	41.5	28.0	10	91.2	61.5	70	140.9	95.1	30	190.7	128.6	90	240.4	162.2
51	42.3	28.5	111	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	12	92.8	62.6	72	142.6	96.2	32	192.3	129.7	92	242.1	163.3
53	43.9	29.6	13	93.7	63.2	73	143.4	96.7	33	193.2	130.3	93	242.9	163.8
54	44.8	30.2	14	94.5	63.7	74	144.2	97.3	34	194.0	130.9	94	243.7	164.4
55	45.6	30.8	15	95.3	64.3	75	145.1	97.9	35	194.8	131.4	95	244.6	165.0
56	46.4	31.3	16	96.2	64.9	76	145.9	98.4	36	195.6	132.0	96	245.4	165.6
57	47.3	31.9	17	97.0	65.4	77	146.7	99.0	37	196.5	132.5	97	246.2	166.1
58	48.1	32.4	18	97.8	66.0	78	147.6	99.5	38	197.3	133.1	98	247.0	166.6
59	48.9	33.0	19	98.7	66.5	79	148.4	100.1	39	198.1	133.6	99	247.9	167.2
60	49.7	33.6	20	99.5	67.1	80	149.2	100.7	40	199.0	134.2	300	248.7	167.8
D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.	D. ft.	Dep.	Lat.

for 56 Degrees.

Difference of Latitude and Departure for 55 Degrees:

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Lat.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.2	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	22	99.9	70.0	82	149.1	104.4	42	198.2	138.8
3	02.5	01.7	63	51.6	36.1	23	100.7	70.5	83	149.9	105.0	43	199.0	139.4
4	03.3	02.3	64	52.4	36.7	24	101.6	71.1	84	150.7	105.5	44	199.8	139.9
5	04.1	02.9	65	53.2	37.3	25	102.4	71.7	85	151.5	106.1	45	200.6	140.5
6	04.9	03.4	66	54.1	37.9	26	103.2	72.3	86	152.3	106.7	46	201.5	141.1
7	05.7	04.0	67	54.9	38.4	27	104.0	72.8	87	153.1	107.2	47	202.3	141.7
8	06.6	04.6	68	55.7	39.0	28	104.8	73.4	88	154.0	107.8	48	203.1	142.2
9	07.4	05.2	69	56.5	39.6	29	105.6	74.0	89	154.8	108.4	49	203.9	142.8
10	08.2	05.7	70	57.3	40.1	30	106.5	74.6	90	155.6	109.0	50	204.7	143.4
11	09.0	06.3	71	58.1	40.7	31	107.3	75.1	91	156.4	109.5	51	205.6	143.9
12	09.8	06.9	72	59.0	41.3	32	108.1	75.7	92	157.2	110.1	52	206.4	144.5
13	10.6	07.5	73	59.8	41.9	33	108.9	76.3	93	158.1	110.7	53	207.2	145.1
14	11.5	08.0	74	60.6	42.4	34	109.7	76.8	94	158.9	111.3	54	208.0	145.7
15	12.3	08.6	75	61.4	43.0	35	110.6	77.4	95	159.7	111.8	55	208.8	146.2
16	13.1	09.2	76	62.2	43.6	36	111.4	78.0	96	160.5	112.4	56	209.6	146.8
17	13.9	09.7	77	63.1	44.2	37	112.2	78.6	97	161.3	113.0	57	210.5	147.4
18	14.7	10.3	78	63.9	44.7	38	113.0	79.1	98	162.2	113.6	58	211.3	148.0
19	15.6	10.9	79	64.7	45.3	39	113.8	79.7	99	163.0	114.1	59	212.1	148.5
20	16.4	11.5	80	65.5	45.9	40	114.6	80.3	200	163.8	114.7	60	212.9	149.1
21	17.2	12.0	81	66.3	46.5	41	115.5	80.9	201	164.6	115.3	61	213.8	149.7
22	18.0	12.6	82	67.2	47.0	42	116.3	81.4	02	165.4	115.8	62	214.6	150.3
23	18.8	13.2	83	68.0	47.6	43	117.1	82.0	03	166.3	116.4	63	215.4	150.8
24	19.6	13.8	84	68.8	48.2	44	117.9	82.6	04	167.1	117.0	64	216.2	151.4
25	20.5	14.3	85	69.6	48.7	45	118.8	83.2	05	167.9	117.6	65	217.0	152.0
26	21.3	14.9	86	70.4	49.3	46	119.6	83.7	06	168.7	118.1	66	217.8	152.6
27	22.1	15.5	87	71.3	49.9	47	120.4	84.3	07	169.5	118.7	67	218.7	153.1
28	22.9	16.1	88	72.1	50.5	48	121.2	84.9	08	170.3	119.3	68	219.5	153.7
29	23.8	16.6	89	72.9	51.0	49	122.0	85.5	09	171.2	119.9	69	220.3	154.3
30	24.6	17.2	90	73.7	51.6	50	122.8	86.0	10	172.0	120.4	70	221.1	154.8
31	25.4	17.8	91	74.5	52.2	51	123.7	86.6	211	172.8	121.0	271	221.9	155.4
32	26.2	18.4	92	75.3	52.8	52	124.5	87.2	12	173.6	121.6	72	222.8	156.0
33	27.0	18.9	93	76.2	53.3	53	125.3	87.7	13	174.4	122.2	73	223.6	156.6
34	27.8	19.5	94	77.0	53.9	54	126.1	88.3	14	175.3	122.7	74	224.4	157.1
35	28.7	20.1	95	77.8	54.5	55	126.9	88.9	15	176.1	123.3	75	225.2	157.7
36	29.5	20.6	96	78.6	55.1	56	127.8	89.5	16	176.9	123.9	76	226.0	158.3
37	30.3	21.2	97	79.4	55.6	57	128.6	90.0	17	177.7	124.4	77	226.9	158.9
38	31.1	21.8	98	80.3	56.2	58	129.4	90.6	18	178.5	125.0	78	227.7	159.4
39	31.9	22.4	99	81.1	56.8	59	130.2	91.2	19	179.4	125.6	79	228.5	160.0
40	32.8	22.9	100	81.9	57.4	60	131.0	91.8	20	180.2	126.2	80	229.3	160.6
41	33.0	23.5	101	82.7	57.9	61	131.9	92.3	211	181.0	126.7	281	230.1	161.2
42	34.4	24.1	02	83.5	58.5	62	132.7	92.9	22	181.8	127.3	82	231.0	161.7
43	35.2	24.7	03	84.4	59.1	63	133.5	93.5	23	182.6	127.9	83	231.8	162.3
44	36.0	25.2	04	85.2	59.6	64	134.3	94.1	24	183.5	128.5	84	232.6	162.9
45	36.9	25.8	05	86.0	60.2	65	135.1	94.6	25	184.2	129.0	85	233.4	163.4
46	37.7	26.4	06	86.8	60.8	66	136.0	95.2	26	185.1	129.6	86	234.2	164.0
47	38.5	27.0	07	87.6	61.4	67	136.8	95.8	27	185.9	130.2	87	235.0	164.6
48	39.3	27.5	08	88.5	61.9	68	137.6	96.3	28	186.7	130.8	88	235.9	165.2
49	40.1	28.1	09	89.3	62.5	69	138.4	96.9	29	187.5	131.3	89	236.7	165.7
50	41.0	28.7	10	90.1	63.1	70	139.2	97.5	30	188.4	131.9	90	237.5	166.3
51	41.8	29.2	111	90.9	63.7	171	140.0	98.1	231	189.2	132.5	291	238.5	166.9
52	42.6	29.8	12	91.7	64.2	72	140.9	98.6	32	190.0	133.1	92	239.1	167.5
53	43.4	30.4	13	92.5	64.8	73	141.7	99.2	33	190.8	133.6	93	240.0	168.0
54	44.2	31.0	14	93.4	65.4	74	142.5	99.8	34	191.6	134.2	94	240.8	168.6
55	45.0	31.5	15	94.2	66.0	75	143.3	100.4	35	192.5	134.8	95	241.6	169.2
56	45.9	32.1	16	95.0	66.5	76	144.1	100.9	36	193.3	135.3	96	242.4	169.8
57	46.7	32.7	17	95.8	67.1	77	145.0	101.5	37	194.1	135.9	97	243.2	170.3
58	47.5	33.3	18	96.6	67.7	78	145.8	102.1	38	194.9	136.5	98	244.1	170.9
59	48.3	33.8	19	97.5	68.2	79	146.6	102.7	39	195.7	137.1	99	244.9	171.5
60	49.1	34.4	20	98.3	68.8	80	147.4	103.2	40	196.6	137.6	300	245.7	172.1
Diff	Dep.	Lat.	Diff	Dep.	Dep.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

Difference of Latitude and Departure for 36 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.8	00.6	61	49.3	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	22	98.7	71.7	82	147.2	107.0	42	195.8	142.2
3	02.4	01.8	63	51.0	37.0	23	99.5	72.3	83	148.0	107.6	43	196.6	142.8
4	03.2	02.4	64	51.8	37.6	24	100.3	72.9	84	148.9	108.2	44	197.4	143.4
5	04.0	02.9	65	52.6	38.2	25	101.1	73.5	85	149.7	108.7	45	198.2	144.0
6	04.9	03.5	66	53.4	38.8	26	101.9	74.1	86	150.5	109.3	46	199.0	144.6
7	05.7	04.1	67	54.2	39.4	27	102.7	74.7	87	151.3	109.9	47	199.8	145.2
8	06.5	04.7	68	55.0	40.0	28	103.6	75.2	88	152.1	110.5	48	200.6	145.8
9	07.3	05.3	69	55.8	40.6	29	104.4	75.8	89	152.9	111.1	49	201.4	146.4
10	08.1	05.9	70	56.6	41.1	30	105.2	76.4	90	153.7	111.7	50	202.2	146.9
11	08.9	06.5	71	57.4	41.7	31	106.0	77.0	91	154.5	112.3	51	203.1	147.5
12	09.7	07.1	72	58.2	42.3	32	106.8	77.6	92	155.3	112.9	52	203.9	148.1
13	10.5	07.6	73	59.1	42.9	33	107.6	78.2	93	156.1	113.4	53	204.7	148.7
14	11.3	08.2	74	59.9	43.5	34	108.4	78.8	94	156.9	114.0	54	205.5	149.3
15	12.1	08.8	75	60.7	44.1	35	109.2	79.4	95	157.8	114.6	55	206.3	149.9
16	12.9	09.4	76	61.5	44.7	36	110.0	79.9	96	158.6	115.2	56	207.1	150.5
17	13.8	10.0	77	62.3	45.3	37	110.8	80.5	97	159.4	115.8	57	207.9	151.1
18	14.6	10.6	78	63.1	45.8	38	111.6	81.1	98	160.2	116.4	58	208.7	151.7
19	15.4	11.2	79	63.9	46.4	39	112.5	81.7	99	161.0	117.0	59	209.5	152.2
20	16.2	11.8	80	64.7	47.0	40	113.3	82.3	200	161.8	117.6	60	210.3	152.8
21	17.0	12.3	81	65.5	47.6	41	114.1	82.9	201	162.6	118.1	261	211.1	153.4
22	17.8	12.9	82	66.3	48.2	42	114.9	83.5	02	163.4	118.7	62	212.0	154.0
23	18.6	13.5	83	67.1	48.8	43	115.7	84.1	03	164.2	119.3	63	212.8	154.6
24	19.4	14.1	84	68.0	49.4	44	116.5	84.6	04	165.0	119.9	64	213.6	155.2
25	20.2	14.7	85	68.8	50.0	45	117.3	85.2	05	165.8	120.5	65	214.4	155.8
26	21.0	15.3	86	69.6	50.6	46	118.1	85.8	06	166.7	121.1	66	215.2	156.4
27	21.8	15.9	87	70.4	51.1	47	118.9	86.4	07	167.5	121.7	67	216.0	156.9
28	22.7	16.5	88	71.2	51.7	48	119.7	87.0	08	168.3	122.3	68	216.8	157.5
29	23.5	17.0	89	72.0	52.3	49	120.5	87.6	09	169.1	122.8	69	217.6	158.1
30	24.3	17.6	90	72.8	52.9	50	121.3	88.2	10	169.9	123.4	70	218.4	158.7
31	25.1	18.2	91	73.6	53.5	51	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	52	123.0	89.3	12	171.5	124.6	72	220.0	159.9
33	26.7	19.4	93	75.2	54.7	53	123.8	89.9	13	172.3	125.2	73	220.9	160.5
34	27.5	20.0	94	76.0	55.3	54	124.6	90.5	14	173.1	125.8	74	221.7	161.1
35	28.3	20.6	95	76.9	55.8	55	125.4	91.1	15	173.9	126.4	75	222.5	161.6
36	29.1	21.2	96	77.7	56.4	56	126.2	91.7	16	174.7	127.0	76	223.3	162.2
37	29.9	21.7	97	78.5	57.0	57	127.0	92.3	17	175.6	127.6	77	224.1	162.8
38	30.7	22.3	98	79.3	57.6	58	127.8	92.9	18	176.4	128.1	78	224.9	163.4
39	31.6	22.9	99	80.1	58.2	59	128.6	93.5	19	177.2	128.7	79	225.7	164.0
40	32.4	23.5	100	80.9	58.8	60	129.4	94.0	20	178.0	129.3	80	226.5	164.6
41	33.2	24.1	101	81.7	59.4	61	130.2	94.6	21	178.8	129.9	281	227.3	165.2
42	34.0	24.7	02	82.5	60.0	62	131.1	95.2	22	179.6	130.5	82	228.1	165.8
43	34.8	25.3	03	83.3	60.5	63	131.9	95.8	23	180.4	131.1	83	228.9	166.3
44	35.6	25.9	04	84.1	61.1	64	132.7	96.4	24	181.2	131.7	84	229.8	166.9
45	36.4	26.5	05	84.9	61.7	65	133.5	97.0	25	182.0	132.3	85	230.6	167.5
46	37.2	27.1	06	85.8	62.3	66	134.3	97.6	26	182.8	132.8	86	231.4	168.1
47	38.0	27.6	07	86.6	62.9	67	135.1	98.2	27	183.6	133.4	87	232.2	168.7
48	38.8	28.2	08	87.4	63.5	68	135.9	98.7	28	184.5	134.0	88	233.0	169.3
49	39.6	28.8	09	88.2	64.1	69	136.7	99.3	29	185.3	134.6	89	233.8	169.9
50	40.5	29.4	10	89.0	64.7	70	137.5	99.9	30	186.1	135.2	90	234.6	170.5
51	41.3	30.0	11	89.8	65.2	71	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	12	90.6	65.8	72	139.1	101.1	32	187.7	136.4	92	236.2	171.6
53	42.9	31.2	13	91.4	66.4	73	140.0	101.7	33	188.5	137.0	93	237.0	172.2
54	43.7	31.7	14	92.2	67.0	74	140.8	102.3	34	189.3	137.5	94	237.8	172.8
55	44.5	32.3	15	93.0	67.6	75	141.6	102.9	35	190.1	138.1	95	238.7	173.4
56	45.3	32.9	16	93.8	68.2	76	142.4	103.5	36	190.9	138.7	96	239.5	174.0
57	46.1	33.5	17	94.7	68.8	77	143.2	104.0	37	191.7	139.3	97	240.3	174.6
58	46.9	34.1	18	95.5	69.4	78	144.0	104.6	38	192.5	139.9	98	241.1	175.2
59	47.7	34.7	19	96.3	69.9	79	144.8	105.2	39	193.3	140.5	99	241.9	175.7
60	48.5	35.3	20	97.1	70.5	80	145.6	105.8	40	194.2	141.1	300	242.7	176.3
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 54 Degrees.

Difference of Latitude and Departure for 37 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.5	181	144.5	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	122	97.4	73.4	82	145.3	109.5	42	193.3	145.6
3	02.4	01.8	63	50.3	37.9	23	98.2	74.0	83	146.1	110.1	43	194.1	146.2
4	03.2	02.4	64	51.1	38.5	24	99.0	74.6	84	146.9	110.7	44	194.9	146.8
5	04.0	03.0	65	51.9	39.1	25	99.8	75.2	85	147.7	111.3	45	195.7	147.4
6	04.8	03.6	66	52.7	39.7	26	100.6	75.8	86	148.5	111.9	46	196.5	148.0
7	05.6	04.3	67	53.5	40.3	27	101.4	76.4	87	149.3	112.5	47	197.3	148.6
8	06.4	04.8	68	54.3	40.9	28	102.2	77.0	88	150.1	113.1	48	198.1	149.2
9	07.2	05.4	69	55.1	41.5	29	103.0	77.6	89	150.9	113.7	49	198.9	149.8
10	08.0	06.0	70	55.9	42.1	30	103.8	78.2	90	151.7	114.3	50	199.7	150.4
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.4	151.0
12	09.6	07.2	72	57.5	43.3	32	105.4	79.4	92	153.3	115.5	52	201.2	151.6
13	10.4	07.8	73	58.3	43.9	33	106.2	80.0	93	154.1	116.1	53	202.0	152.2
14	11.2	08.4	74	59.1	44.5	34	107.0	80.6	94	154.9	116.7	54	202.8	152.8
15	12.0	09.0	75	59.9	45.1	35	107.8	81.2	95	155.7	117.3	55	203.6	153.4
16	12.8	09.6	76	60.7	45.7	36	108.6	81.8	96	156.5	117.9	56	204.4	154.0
17	13.6	10.2	77	61.5	46.3	37	109.4	82.4	97	157.3	118.6	57	205.2	154.6
18	14.4	10.8	78	62.3	46.9	38	110.2	83.0	98	158.1	119.2	58	206.0	155.2
19	15.2	11.4	79	63.1	47.5	39	111.0	83.6	99	158.9	119.8	59	206.8	155.8
20	16.0	12.0	80	63.9	48.1	40	111.8	84.2	200	159.7	120.4	60	207.6	156.4
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.0
22	17.6	13.2	82	65.5	49.3	42	113.4	85.5	02	161.3	121.6	62	209.2	157.6
23	18.4	13.8	83	66.3	49.9	43	114.2	86.1	03	162.1	122.2	63	210.0	158.2
24	19.2	14.4	84	67.1	50.6	44	115.0	86.7	04	162.9	122.8	64	210.8	158.8
25	20.0	15.0	85	67.9	51.2	45	115.8	87.3	05	163.7	123.4	65	211.6	159.4
26	20.8	15.6	86	68.7	51.8	46	116.6	87.9	06	164.5	124.0	66	212.4	160.0
27	21.6	16.2	87	69.5	52.4	47	117.4	88.5	07	165.3	124.6	67	213.2	160.6
28	22.4	16.9	88	70.3	53.0	48	118.2	89.1	08	166.1	125.2	68	214.0	161.2
29	23.2	17.5	89	71.1	53.6	49	119.0	89.7	09	166.9	125.8	69	214.8	161.8
30	24.0	18.1	90	71.9	54.2	50	119.8	90.3	10	167.7	126.4	70	215.6	162.4
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.0
32	25.6	19.3	92	73.5	55.4	52	121.4	91.5	12	169.3	127.6	72	217.2	163.6
33	26.4	19.9	93	74.3	56.0	53	122.2	92.1	13	170.1	128.2	73	218.0	164.2
34	27.2	20.5	94	75.1	56.6	54	123.0	92.7	14	170.9	128.8	74	218.8	164.8
35	28.0	21.1	95	75.9	57.2	55	123.8	93.3	15	171.7	129.4	75	219.6	165.4
36	28.8	21.7	96	76.7	57.8	56	124.6	93.9	16	172.5	130.0	76	220.4	166.0
37	29.5	22.3	97	77.5	58.4	57	125.4	94.5	17	173.3	130.6	77	221.2	166.6
38	30.3	22.9	98	78.3	59.0	58	126.2	95.1	18	174.1	131.2	78	222.0	167.2
39	31.1	23.5	99	79.1	59.6	59	127.0	95.7	19	174.9	131.8	79	222.8	167.8
40	31.9	24.1	100	79.9	60.2	60	127.8	96.3	20	175.7	132.4	80	223.6	168.4
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.0
42	33.5	25.3	02	81.5	61.4	62	129.4	97.5	22	177.3	133.6	82	225.2	169.6
43	34.3	25.9	03	82.3	62.0	63	130.2	98.1	23	178.1	134.2	83	226.0	170.2
44	35.1	26.5	04	83.1	62.6	64	131.0	98.7	24	178.9	134.8	84	226.8	170.8
45	35.9	27.1	05	83.9	63.2	65	131.8	99.3	25	179.7	135.4	85	227.6	171.4
46	36.7	27.7	06	84.7	63.8	66	132.6	99.9	26	180.5	136.0	86	228.4	172.0
47	37.5	28.3	07	85.5	64.4	67	133.4	100.5	27	181.3	136.6	87	229.2	172.6
48	38.3	28.9	08	86.3	65.0	68	134.2	101.1	28	182.1	137.2	88	230.0	173.2
49	39.1	29.5	09	87.1	65.6	69	135.0	101.7	29	182.9	137.8	89	230.8	173.8
50	39.9	30.1	10	87.9	66.2	70	135.8	102.3	30	183.7	138.4	90	231.6	174.4
51	40.7	30.7	11	88.7	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.0
52	41.5	31.3	12	89.4	67.4	72	137.4	103.5	32	185.3	139.6	92	233.2	175.6
53	42.3	31.9	13	90.2	68.0	73	138.2	104.1	33	186.1	140.2	93	234.0	176.2
54	43.1	32.5	14	91.0	68.6	74	139.0	104.7	34	186.9	140.8	94	234.8	176.8
55	43.9	33.1	15	91.8	69.2	75	139.8	105.3	35	187.7	141.4	95	235.6	177.4
56	44.7	33.7	16	92.6	69.8	76	140.6	105.9	36	188.5	142.0	96	236.4	178.0
57	45.5	34.3	17	93.4	70.4	77	141.4	106.5	37	189.3	142.6	97	237.2	178.6
58	46.3	34.9	18	94.2	71.0	78	142.2	107.1	38	190.1	143.2	98	238.0	179.2
59	47.1	35.5	19	95.0	71.6	79	143.0	107.7	39	190.9	143.8	99	238.8	179.8
60	47.9	36.1	20	95.8	72.2	80	143.8	108.3	40	191.7	144.4	30	239.6	180.4
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

for 53 Degrees.

Difference of Latitude and Departure for 38 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	22	96.1	75.1	82	143.4	112.1	42	190.7	149.0
3	02.4	01.8	63	49.6	38.8	23	96.9	75.7	83	144.2	112.7	43	191.5	149.6
4	03.2	02.5	64	50.4	39.4	24	97.7	76.3	84	145.0	113.3	44	192.2	150.2
5	03.9	03.1	65	51.2	40.0	25	98.5	77.0	85	145.8	113.9	45	193.0	150.8
6	04.7	03.7	66	52.0	40.6	26	99.3	77.6	86	146.5	114.5	46	193.8	151.5
7	05.5	04.3	67	52.8	41.3	27	100.1	78.2	87	147.3	115.1	47	194.6	152.1
8	06.3	04.9	68	53.6	41.9	28	100.9	78.8	88	148.1	115.8	48	195.4	152.7
9	07.1	05.5	69	54.4	42.5	29	101.6	79.4	89	148.9	116.4	49	196.2	153.3
10	07.9	06.2	70	55.2	43.1	30	102.4	80.0	90	149.7	117.0	50	197.0	153.9
11	08.7	06.8	71	55.9	43.7	31	103.2	80.7	91	150.5	117.6	51	197.8	154.5
12	09.5	07.4	72	56.7	44.3	32	104.0	81.3	92	151.3	118.2	52	198.5	155.2
13	10.2	08.0	73	57.5	44.9	33	104.8	81.9	93	152.1	118.8	53	199.3	155.8
14	11.0	08.6	74	58.3	45.6	34	105.6	82.5	94	152.9	119.4	54	200.1	156.4
15	11.8	09.2	75	59.1	46.2	35	106.4	83.1	95	153.6	120.1	55	200.9	157.0
16	12.6	09.9	76	59.9	46.8	36	107.2	83.7	96	154.4	120.7	56	201.7	157.6
17	13.4	10.5	77	60.7	47.4	37	107.9	84.4	97	155.2	121.3	57	202.5	158.2
18	14.2	11.1	78	61.5	48.0	38	108.7	85.0	98	156.0	121.9	58	203.3	158.9
19	15.0	11.7	79	62.2	48.6	39	109.5	85.6	99	156.8	122.5	59	204.1	159.5
20	15.8	12.3	80	63.0	49.3	40	110.3	86.2	200	157.6	123.1	60	204.9	160.1
21	16.5	12.9	81	63.8	49.9	41	111.1	86.8	201	158.4	123.8	261	205.6	160.7
22	17.3	13.5	82	64.6	50.5	42	111.9	87.4	02	159.2	124.4	62	206.4	161.3
23	18.1	14.2	83	65.4	51.1	43	112.7	88.0	03	159.9	125.0	63	207.2	161.9
24	18.9	14.8	84	66.2	51.7	44	113.5	88.7	04	160.7	125.6	64	208.0	162.5
25	19.7	15.4	85	67.0	52.3	45	114.2	89.3	05	161.5	126.2	65	208.8	163.2
26	20.5	16.0	86	67.8	53.0	46	115.0	89.9	06	162.3	126.8	66	209.6	163.8
27	21.3	16.6	87	68.5	53.6	47	115.8	90.5	07	163.1	127.4	67	210.4	164.4
28	22.1	17.2	88	69.3	54.2	48	116.6	91.1	08	163.9	128.1	68	211.2	165.0
29	22.9	17.9	89	70.1	54.8	49	117.4	91.7	09	164.7	128.7	69	211.9	165.6
30	23.6	18.5	90	70.9	55.4	50	118.2	92.4	10	165.5	129.3	70	212.7	166.2
31	24.4	19.1	91	71.7	56.0	51	119.0	93.0	211	166.2	129.9	271	213.5	166.9
32	25.2	19.7	92	72.5	56.6	52	119.8	93.6	12	167.0	130.5	72	214.3	167.5
33	26.0	20.3	93	73.3	57.3	53	120.5	94.2	13	167.8	131.1	73	215.1	168.1
34	26.8	20.9	94	74.1	57.9	54	121.3	94.8	14	168.6	131.8	74	215.9	168.7
35	27.6	21.5	95	74.9	58.5	55	122.1	95.4	15	169.4	132.4	75	216.7	169.3
36	28.4	22.2	96	75.6	59.1	56	122.9	96.0	16	170.2	133.0	76	217.5	169.9
37	29.2	22.8	97	76.4	59.7	57	123.7	96.7	17	171.0	133.6	77	218.2	170.5
38	29.9	23.4	98	77.2	60.3	58	124.5	97.3	18	171.8	134.2	78	219.0	171.2
39	30.7	24.0	99	78.0	61.0	59	125.3	97.9	19	172.5	134.8	79	219.8	171.8
40	31.5	24.6	100	78.8	61.6	60	126.1	98.5	20	173.3	135.5	80	220.6	172.4
41	32.3	25.2	101	79.6	62.2	101	126.9	99.1	221	174.1	136.1	281	221.4	173.0
42	33.1	25.9	02	80.4	62.8	62	127.6	99.7	22	174.9	136.7	82	222.2	173.6
43	33.9	26.5	03	81.2	63.4	63	128.4	100.4	23	175.7	137.3	83	223.0	174.2
44	34.7	27.1	04	81.9	64.0	64	129.2	101.0	24	176.5	137.9	84	223.8	174.9
45	35.5	27.7	05	82.7	64.6	65	130.0	101.6	25	177.3	138.5	85	224.5	175.5
46	36.2	28.3	06	83.5	65.3	66	130.8	102.2	26	178.1	139.1	86	225.3	176.1
47	37.0	28.9	07	84.3	65.9	67	131.6	102.8	27	178.9	139.8	87	226.1	176.7
48	37.8	29.6	08	85.1	66.5	68	132.4	103.4	28	179.6	140.4	88	226.9	177.3
49	38.6	30.2	09	85.9	67.1	69	133.2	104.1	29	180.4	141.0	89	227.7	177.9
50	39.4	30.8	10	86.7	67.7	70	133.9	104.7	30	181.2	141.6	90	228.5	178.6
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	12	88.2	69.0	72	135.5	105.9	32	182.8	142.8	92	230.1	179.8
53	41.8	32.6	13	89.0	69.6	73	136.3	106.5	33	183.6	143.5	93	230.9	180.4
54	42.5	33.2	14	89.8	70.2	74	137.1	107.1	34	184.4	144.1	94	231.6	181.0
55	43.3	33.9	15	90.6	70.8	75	137.9	107.7	35	185.2	144.7	95	232.4	181.6
56	44.1	34.5	16	91.4	71.4	76	138.7	108.4	36	185.9	145.3	96	233.2	182.2
57	44.9	35.1	17	92.2	72.0	77	139.5	109.0	37	186.7	145.9	97	234.0	182.9
58	45.7	35.7	18	93.0	72.7	78	140.2	109.6	38	187.5	146.5	98	234.8	183.5
59	46.5	36.3	19	93.8	73.3	79	141.0	110.2	39	188.3	147.2	99	235.6	184.1
60	47.3	36.9	20	94.5	73.9	80	141.8	110.8	40	189.1	147.8	300	236.4	184.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

for 52 Degrees.

Difference of Latitude and Departure for 39 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	22	94.8	76.8	82	141.4	114.5	42	188.1	152.3
3	02.3	01.9	63	49.0	39.6	23	95.6	77.4	83	142.2	115.2	43	188.8	152.9
4	03.1	02.5	64	49.7	40.3	24	96.4	78.0	84	143.0	115.8	44	189.6	153.6
5	03.9	03.1	65	50.5	40.9	25	97.1	78.7	85	143.8	116.4	45	190.4	154.2
6	04.7	03.8	66	51.3	41.5	26	97.9	79.3	86	144.5	117.1	46	191.2	154.8
7	05.4	04.4	67	52.1	42.2	27	98.7	79.9	87	145.3	117.7	47	191.9	155.4
8	06.2	05.0	68	52.8	42.8	28	99.5	80.6	88	146.1	118.3	48	192.7	156.1
9	07.0	05.7	69	53.6	43.4	29	100.2	81.2	89	146.9	118.9	49	193.5	156.7
10	07.8	06.3	70	54.4	44.1	30	101.0	81.8	90	147.6	119.6	50	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	32	102.6	83.1	92	149.2	120.8	52	195.8	158.6
13	10.1	08.2	73	56.7	45.9	33	103.4	83.7	93	150.0	121.5	53	196.6	159.2
14	10.9	08.8	74	57.5	46.6	34	104.1	84.3	94	150.8	122.1	54	197.4	159.8
15	11.7	09.4	75	58.3	47.2	35	104.9	85.0	95	151.5	122.7	55	198.2	160.5
16	12.4	10.1	76	59.1	47.8	36	105.7	85.6	96	152.3	123.3	56	198.9	161.1
17	13.2	10.7	77	59.8	48.5	37	106.5	86.2	97	153.1	124.0	57	199.7	161.7
18	14.0	11.3	78	60.6	49.1	38	107.2	86.8	98	153.9	124.6	58	200.5	162.4
19	14.8	12.0	79	61.4	49.7	39	108.0	87.5	99	154.6	125.2	59	201.3	163.0
20	15.5	12.6	80	62.2	50.3	40	108.8	88.1	200	155.4	125.9	60	202.0	163.6
21	16.3	13.2	81	62.9	51.0	141	109.6	88.7	201	156.2	126.5	261	202.8	164.2
22	17.1	13.8	82	63.7	51.6	42	110.3	89.4	02	157.0	127.1	62	203.6	164.9
23	17.9	14.5	83	64.5	52.2	43	111.1	90.0	03	157.8	127.7	63	204.4	165.5
24	18.7	15.1	84	65.3	52.9	44	111.9	90.6	04	158.5	128.4	64	205.2	166.1
25	19.4	15.7	85	66.1	53.5	45	112.7	91.2	05	159.3	129.0	65	205.9	166.8
26	20.2	16.4	86	66.8	54.1	46	113.5	91.9	06	160.1	129.6	66	206.7	167.4
27	21.0	17.0	87	67.6	54.7	47	114.2	92.5	07	160.9	130.3	67	207.5	168.0
28	21.8	17.6	88	68.4	55.4	48	115.0	93.1	08	161.6	130.9	68	208.3	168.7
29	22.5	18.2	89	69.2	56.0	49	115.8	93.8	09	162.4	131.5	69	209.0	169.3
30	23.3	18.9	90	69.9	56.6	50	116.6	94.4	10	163.2	132.2	70	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	52	118.1	95.7	12	164.7	133.4	72	211.4	171.2
33	25.6	20.8	93	72.5	58.5	53	118.9	96.3	13	165.5	134.0	73	212.1	171.8
34	26.4	21.4	94	73.0	59.2	54	119.7	96.9	14	166.3	134.7	74	212.9	172.4
35	27.2	22.0	95	73.8	59.8	55	120.5	97.5	15	167.1	135.3	75	213.7	173.1
36	28.0	22.7	96	74.6	60.4	56	121.2	98.2	16	167.9	135.9	76	214.5	173.7
37	28.8	23.3	97	75.4	60.9	57	122.0	98.8	17	168.6	136.6	77	215.3	174.3
38	29.5	23.9	98	76.2	61.7	58	122.8	99.4	18	169.4	137.2	78	216.0	174.9
39	30.3	24.5	99	76.9	62.3	59	123.6	100.1	19	170.2	137.8	79	216.8	175.6
40	31.1	25.2	100	77.7	62.9	60	124.3	100.7	20	171.0	138.4	80	217.6	176.2
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	02	79.3	64.2	62	125.9	101.9	22	172.5	139.7	82	219.1	177.5
43	33.4	27.1	03	80.0	64.8	63	126.7	102.6	23	173.3	140.3	83	219.9	178.1
44	34.2	27.7	04	80.8	65.4	64	127.4	103.2	24	174.1	141.0	84	220.7	178.7
45	35.0	28.3	05	81.6	66.1	65	128.2	103.8	25	174.8	141.6	85	221.5	179.4
46	35.7	28.9	06	82.4	66.7	66	129.0	104.5	26	175.6	142.2	86	222.3	180.0
47	36.5	29.6	07	83.1	67.3	67	129.8	105.1	27	176.4	142.9	87	223.0	180.6
48	37.3	30.2	08	83.9	68.0	68	130.6	105.7	28	177.2	143.5	88	223.8	181.2
49	38.1	30.8	09	84.7	68.6	69	131.3	106.4	29	178.0	144.1	89	224.6	181.9
50	38.9	31.5	10	85.5	69.2	70	132.1	107.0	30	178.7	144.7	90	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	12	87.0	70.5	72	133.7	108.2	32	180.3	146.0	92	226.9	183.8
53	41.2	33.4	13	87.8	71.1	73	134.4	108.9	33	181.1	146.6	93	227.7	184.4
54	42.0	34.0	14	88.6	71.7	74	135.2	109.5	34	181.8	147.3	94	228.5	185.0
55	42.7	34.6	15	89.4	72.4	75	136.0	110.1	35	182.6	147.9	95	229.2	185.6
56	43.5	35.2	16	90.1	73.0	76	136.8	110.8	36	183.4	148.5	96	230.0	186.3
57	44.3	35.9	17	90.9	73.6	77	137.5	111.4	37	184.2	149.1	97	230.8	186.9
58	45.1	36.5	18	91.7	74.3	78	138.3	112.0	38	185.0	149.8	98	231.6	187.5
59	45.8	37.1	19	92.5	74.9	79	139.1	112.6	39	185.7	150.4	99	232.4	188.2
60	46.6	37.8	20	93.3	75.5	80	139.9	113.3	40	186.5	151.0	300	233.1	188.8
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 51 Degrees.

Difference of Latitude and Departure for 40 Degrees.

Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.6	116.4	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	22	93.4	78.4	82	139.4	117.0	42	185.4	155.6
3	02.3	01.9	63	48.3	40.5	23	94.2	79.1	83	140.2	117.7	43	186.1	156.2
4	03.1	02.6	64	49.0	41.1	24	95.0	79.7	84	140.9	118.3	44	186.9	156.9
5	03.8	03.2	65	49.8	41.8	25	95.7	80.4	85	141.7	118.9	45	187.7	157.5
6	04.6	03.9	66	50.6	42.4	26	96.5	81.0	86	142.5	119.6	46	188.4	158.1
7	05.4	04.5	67	51.3	43.1	27	97.3	81.6	87	143.2	120.2	47	189.2	158.8
8	06.1	05.1	68	52.1	43.7	28	98.0	82.3	88	144.0	120.9	48	190.0	159.4
9	06.9	05.8	69	52.9	44.4	29	98.8	82.9	89	144.8	121.5	49	190.7	160.1
10	07.7	06.4	70	53.6	45.0	30	99.6	83.6	90	145.5	122.1	50	191.5	160.7
11	08.4	07.1	71	54.4	45.6	31	100.3	84.2	91	146.3	122.8	51	192.3	161.4
12	09.2	07.7	72	55.2	46.3	32	101.1	84.9	92	147.1	123.4	52	193.0	162.0
13	10.0	08.4	73	55.9	46.9	33	101.9	85.5	93	147.8	124.1	53	193.8	162.6
14	10.7	09.0	74	56.7	47.6	34	102.6	86.1	94	148.6	124.7	54	194.6	163.3
15	11.5	09.6	75	57.4	48.2	35	103.4	86.8	95	149.4	125.4	55	195.3	163.9
16	12.3	10.3	76	58.2	48.9	36	104.2	87.4	96	150.1	126.0	56	196.1	164.6
17	13.0	10.9	77	59.0	49.5	37	104.9	88.1	97	150.9	126.6	57	196.9	165.2
18	13.8	11.6	78	59.7	50.1	38	105.7	88.7	98	151.7	127.3	58	197.6	165.9
19	14.6	12.2	79	60.5	50.8	39	106.5	89.4	99	152.4	127.9	59	198.4	166.5
20	15.3	12.9	80	61.3	51.4	40	107.2	90.0	100	153.2	128.6	60	199.2	167.1
21	16.1	13.5	81	62.0	52.1	41	108.0	90.6	101	154.0	129.2	61	199.9	167.8
22	16.9	14.1	82	62.8	52.7	42	108.8	91.3	102	154.7	129.9	62	200.7	168.4
23	17.6	14.8	83	63.6	53.4	43	109.5	91.9	103	155.5	130.5	63	201.4	169.1
24	18.4	15.4	84	64.3	54.0	44	110.3	92.6	104	156.3	131.1	64	202.2	169.7
25	19.2	16.1	85	65.1	54.6	45	111.1	93.2	105	157.0	131.8	65	203.0	170.4
26	19.9	16.7	86	65.9	55.3	46	111.8	93.9	106	157.8	132.4	66	203.7	171.0
27	20.7	17.4	87	66.6	55.9	47	112.6	94.5	107	158.6	133.1	67	204.5	171.6
28	21.4	18.0	88	67.4	56.6	48	113.4	95.1	108	159.3	133.7	68	205.3	172.3
29	22.2	18.6	89	68.2	57.2	49	114.6	95.8	109	160.1	134.4	69	206.0	172.9
30	23.0	19.3	90	68.9	57.9	50	114.9	96.4	110	160.9	135.0	70	206.8	173.6
31	23.7	19.9	91	69.7	58.5	51	115.7	97.1	111	161.6	135.6	71	207.6	174.2
32	24.5	20.6	92	70.5	59.1	52	116.4	97.7	112	162.4	136.3	72	208.3	174.8
33	25.3	21.2	93	71.2	59.8	53	117.2	98.4	113	163.2	136.9	73	209.1	175.5
34	26.0	21.9	94	72.0	60.4	54	118.0	99.0	114	163.9	137.6	74	209.9	176.1
35	26.8	22.5	95	72.8	61.1	55	118.7	99.6	115	164.7	138.2	75	210.6	176.8
36	27.6	23.1	96	73.5	61.7	56	119.5	100.3	116	165.4	138.8	76	211.4	177.4
37	28.3	23.8	97	74.3	62.4	57	120.3	100.9	117	166.2	139.5	77	212.2	178.1
38	29.1	24.4	98	75.1	63.0	58	121.0	101.6	118	167.0	140.1	78	212.9	178.7
39	29.9	25.1	99	75.8	63.6	59	121.8	102.2	119	167.7	140.8	79	213.7	179.3
40	30.6	25.7	100	76.6	64.3	60	122.6	102.8	120	168.5	141.4	80	214.5	180.0
41	31.4	26.4	101	77.4	64.9	61	123.3	103.5	121	169.3	142.1	81	215.2	180.6
42	32.2	27.0	102	78.1	65.6	62	124.1	104.1	122	170.0	142.7	82	216.0	181.3
43	32.9	27.6	103	78.9	66.2	63	124.9	104.8	123	170.8	143.3	83	216.8	181.9
44	33.7	28.3	104	79.7	66.8	64	125.6	105.4	124	171.6	144.0	84	217.5	182.6
45	34.5	28.9	105	80.4	67.5	65	126.4	106.1	125	172.3	144.6	85	218.3	183.2
46	35.2	29.6	106	81.2	68.1	66	127.2	106.7	126	173.1	145.3	86	219.1	183.9
47	36.0	30.2	107	82.0	68.8	67	127.9	107.3	127	173.9	145.9	87	219.8	184.5
48	36.8	30.8	108	82.7	69.4	68	128.7	108.0	128	174.6	146.6	88	220.6	185.1
49	37.5	31.5	109	83.5	70.1	69	129.4	108.6	129	175.4	147.2	89	221.4	185.8
50	38.3	32.1	110	84.3	70.7	70	130.2	109.3	130	176.2	147.9	90	222.5	186.4
51	39.1	32.8	111	85.0	71.3	71	131.0	109.9	131	176.9	148.5	91	222.9	187.1
52	39.8	33.4	112	85.8	72.0	72	131.7	110.6	132	177.7	149.1	92	223.7	187.7
53	40.6	34.1	113	86.6	72.6	73	132.5	111.2	133	178.5	149.8	93	224.4	188.4
54	41.4	34.7	114	87.3	73.3	74	133.3	111.9	134	179.2	150.4	94	225.2	189.0
55	42.1	35.3	115	88.1	73.9	75	134.0	112.5	135	180.0	151.1	95	226.0	189.6
56	42.9	36.0	116	88.9	74.6	76	134.8	113.1	136	180.8	151.7	96	226.7	190.3
57	43.7	36.6	117	89.6	75.2	77	135.6	113.8	137	181.5	152.4	97	227.5	190.9
58	44.4	37.3	118	90.4	75.9	78	136.3	114.4	138	182.3	153.0	98	228.3	191.6
59	45.2	37.6	119	91.2	76.5	79	137.1	115.1	139	183.1	153.6	99	229.0	192.2
60	46.0	38.6	120	91.9	77.1	80	137.9	115.7	140	183.8	154.3	100	229.8	192.9
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 50 Degrees.

Difference of Latitude and Departure for 41 Degrees.

Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.	Diff	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	01.5	01.3	62	46.8	40.7	22	92.1	80.0	82	137.4	119.4	42	182.6	153.7
3	02.3	02.0	63	47.5	41.3	23	92.8	80.7	83	138.1	120.0	43	183.4	159.4
4	03.0	02.6	64	48.3	42.0	24	93.6	81.3	84	138.9	120.7	44	184.2	160.0
5	03.8	03.3	65	49.1	42.6	25	94.3	82.0	85	139.6	121.4	45	184.9	160.7
6	04.5	03.9	66	49.8	43.3	26	95.1	82.6	86	140.4	122.0	46	185.7	161.4
7	05.3	04.6	67	50.6	44.0	27	95.8	83.3	87	141.1	122.7	47	186.4	162.0
8	06.0	05.2	68	51.3	44.6	28	96.6	84.0	88	141.9	123.3	48	187.2	162.7
9	06.8	05.9	69	52.1	45.3	29	97.4	84.6	89	142.6	124.0	49	187.9	163.3
10	07.5	06.6	70	52.8	45.9	30	98.1	85.3	90	143.4	124.6	50	188.7	164.0
11	08.3	07.2	71	53.6	46.6	31	98.9	85.9	91	144.2	125.3	51	189.4	164.6
12	09.1	07.9	72	54.3	47.2	32	99.6	86.6	92	144.9	125.9	52	190.2	165.3
13	09.8	08.5	73	55.1	47.9	33	100.4	87.2	93	145.7	126.6	53	190.9	166.0
14	10.6	09.2	74	55.8	48.5	34	101.1	87.9	94	146.4	127.3	54	191.7	166.6
15	11.3	09.8	75	56.6	49.2	35	101.9	88.6	95	147.2	127.9	55	192.5	167.3
16	12.1	10.5	76	57.4	49.9	36	102.6	89.2	96	147.9	128.6	56	193.2	167.9
17	12.8	11.2	77	58.1	50.5	37	103.4	89.9	97	148.7	129.2	57	194.0	168.6
18	13.6	11.8	78	58.9	51.2	38	104.2	90.5	98	149.4	129.9	58	194.7	169.2
19	14.3	12.5	79	59.6	51.8	39	104.9	91.2	99	150.2	130.5	59	195.5	169.9
20	15.1	13.1	80	60.4	52.5	40	105.7	91.8	200	150.9	131.2	60	196.2	170.5
21	15.8	13.8	81	61.1	53.1	41	106.4	92.5	201	151.7	131.8	61	197.0	171.2
22	16.6	14.4	82	61.9	53.8	42	107.2	93.1	02	152.5	132.5	62	197.7	171.9
23	17.4	15.1	83	62.6	54.4	43	107.9	93.8	03	153.2	133.2	63	198.5	172.5
24	18.1	15.7	84	63.4	55.1	44	108.7	94.5	04	154.0	133.8	64	199.2	173.2
25	18.9	16.4	85	64.2	55.8	45	109.4	95.1	05	154.7	134.5	65	200.0	173.8
26	19.6	17.1	86	64.9	56.4	46	110.2	95.8	06	155.5	135.1	66	200.8	174.5
27	20.4	17.7	87	65.7	57.1	47	110.9	96.4	07	156.2	135.8	67	201.5	175.1
28	21.1	18.4	88	66.4	57.7	48	111.7	97.1	08	157.0	136.4	68	202.3	175.8
29	21.9	19.0	89	67.2	58.4	49	112.5	97.7	09	157.7	137.1	69	203.0	176.4
30	22.6	19.7	90	67.9	59.0	50	113.2	98.4	10	158.5	137.7	70	203.8	177.1
31	23.4	20.3	91	68.7	59.7	51	114.0	99.0	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	52	114.7	99.7	12	160.0	139.1	72	205.3	178.4
33	24.9	21.6	93	70.2	61.0	53	115.5	100.4	13	160.8	139.7	73	206.0	179.1
34	25.7	22.3	94	70.9	61.7	54	116.2	101.0	14	161.5	140.4	74	206.8	179.7
35	26.4	23.0	95	71.7	62.3	55	117.0	101.7	15	162.3	141.0	75	207.5	180.4
36	27.2	23.6	96	72.5	63.0	56	117.7	102.3	16	163.0	141.7	76	208.3	181.0
37	27.9	24.3	97	73.2	63.6	57	118.5	103.0	17	163.6	142.3	77	209.1	181.7
38	28.7	24.9	98	74.0	64.3	58	119.2	103.6	18	164.5	143.0	78	209.8	182.4
39	29.4	25.6	99	74.7	64.9	59	120.0	104.3	19	165.3	143.6	79	210.6	183.0
40	30.2	26.2	100	75.5	65.6	60	120.8	105.0	20	166.0	144.3	80	211.3	183.7
41	30.9	26.9	101	76.2	66.3	61	121.5	105.6	221	166.8	145.0	281	212.1	184.3
42	31.7	27.6	02	77.0	66.9	62	122.3	106.3	22	167.5	145.6	82	212.8	185.0
43	32.5	28.2	03	77.7	67.6	63	123.0	106.9	23	168.3	146.3	83	213.6	185.6
44	33.2	28.9	04	78.5	68.2	64	123.8	107.6	24	169.1	146.9	84	214.3	186.3
45	34.0	29.5	05	79.2	68.9	65	124.5	108.2	25	169.8	147.6	85	215.1	186.9
46	34.7	30.2	06	80.0	69.5	66	125.3	108.9	26	170.6	148.2	86	215.8	187.0
47	35.5	30.8	07	80.8	70.2	67	126.0	109.5	27	171.3	148.9	87	216.6	188.3
48	36.2	31.5	08	81.5	70.8	68	126.8	110.2	28	172.1	149.6	88	217.4	188.9
49	37.0	32.1	09	82.3	71.5	69	127.5	110.9	29	172.8	150.2	89	218.1	189.0
50	37.7	32.8	10	83.0	72.2	70	128.3	111.5	30	173.6	150.9	90	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	12	84.5	73.5	72	129.8	112.8	32	175.1	152.2	92	220.4	191.5
53	40.0	34.8	13	85.3	74.1	73	130.6	113.5	33	175.8	152.8	93	221.1	192.2
54	40.8	35.4	14	86.0	74.8	74	131.3	114.1	34	176.6	153.5	94	221.9	192.8
55	41.5	36.1	15	86.8	75.4	75	132.1	114.8	35	177.4	154.1	95	222.6	193.5
56	42.3	36.7	16	87.5	76.1	76	132.8	115.4	36	178.1	154.8	96	223.4	194.2
57	43.0	37.4	17	88.3	76.7	77	133.6	116.1	37	178.9	155.5	97	224.2	194.8
58	43.8	38.0	18	89.1	77.4	78	134.3	116.8	38	179.6	156.1	98	224.9	195.5
59	44.5	38.7	19	89.8	78.1	79	135.1	117.4	39	180.4	156.8	99	225.7	196.1
60	45.3	39.4	20	90.6	78.7	80	135.8	118.1	40	181.1	157.4	300	226.4	196.8
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

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for 49 Degrees

Difference of Latitude and Departure for 42 Degrees.

Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.	Diff	Lat	Dep.
1	00.7	00.7	61	45.3	40.8	121	89.9	80.9	181	134.5	121.1	241	179.0	161.2
2	01.5	01.3	62	46.1	41.5	22	90.6	81.6	82	135.2	121.8	42	179.8	161.9
3	02.2	02.0	63	46.8	42.1	23	91.4	82.3	83	135.9	122.4	43	180.5	162.6
4	03.0	02.7	64	47.5	42.8	24	92.1	83.0	84	136.7	123.1	44	181.3	163.2
5	03.7	03.3	65	48.3	43.5	25	92.9	83.6	85	137.3	123.8	45	182.0	163.9
6	04.5	04.0	66	49.0	44.2	26	93.6	84.3	86	138.2	124.4	46	182.7	164.6
7	05.2	04.7	67	49.8	44.8	27	94.3	85.0	87	138.9	125.1	47	183.5	165.2
8	05.9	05.4	68	50.5	45.5	28	95.1	85.6	88	139.7	125.8	48	184.2	165.9
9	06.7	06.0	69	51.3	46.2	29	95.8	86.3	89	140.4	126.4	49	185.0	166.6
10	07.4	06.7	70	52.0	46.8	30	96.6	87.0	90	141.1	127.1	50	185.7	167.2
11	08.2	07.4	71	52.7	47.5	31	97.3	87.6	191	141.9	127.8	251	186.5	167.9
12	08.9	08.0	72	53.5	48.2	32	98.1	88.3	92	142.6	128.4	52	187.2	168.6
13	09.7	08.7	73	54.2	48.8	33	98.8	89.0	93	143.4	129.1	53	187.9	169.3
14	10.4	09.4	74	55.0	49.5	34	99.5	89.6	94	145.1	129.8	54	188.7	169.9
15	11.1	10.0	75	55.7	50.2	35	100.3	90.3	95	144.9	130.5	55	189.4	170.6
16	11.9	10.7	76	56.5	50.8	36	101.0	91.0	96	145.6	131.1	56	190.2	171.3
17	12.6	11.4	77	57.2	51.5	37	101.8	91.7	97	146.3	131.8	57	190.9	171.9
18	13.4	12.0	78	57.9	52.2	38	102.5	92.3	98	147.1	132.5	58	191.7	172.6
19	14.1	12.7	79	58.7	52.9	39	103.3	93.0	99	147.8	133.1	59	192.4	173.3
20	14.9	13.4	80	59.4	53.5	40	104.0	93.7	200	148.6	133.8	60	193.1	173.9
21	15.6	14.0	81	60.2	54.2	41	104.7	94.3	201	149.3	134.5	261	193.9	174.6
22	16.3	14.7	82	60.9	54.9	42	105.5	95.0	02	150.1	135.1	62	194.6	175.3
23	17.1	15.4	83	61.7	55.5	43	106.2	95.7	03	150.8	135.8	63	195.4	175.9
24	17.8	16.1	84	62.4	56.2	44	107.0	96.3	04	151.5	136.5	64	196.1	176.6
25	18.6	16.7	85	63.1	56.9	45	107.7	97.0	05	152.3	137.1	65	196.9	177.3
26	19.3	17.4	86	63.9	57.5	46	108.5	97.7	06	153.0	137.8	66	197.6	177.9
27	20.1	18.1	87	64.6	58.2	47	109.2	98.3	07	153.8	138.5	67	198.3	178.6
28	20.8	18.7	88	65.4	58.9	48	109.9	99.0	08	154.5	139.1	68	199.1	179.3
29	21.5	19.4	89	66.1	59.5	49	110.7	99.7	09	155.3	139.8	69	199.8	180.0
30	22.3	20.1	90	66.9	60.2	50	111.4	100.4	10	156.0	140.5	70	200.6	180.6
31	23.0	20.7	91	67.6	60.9	151	112.2	101.0	211	156.7	141.2	271	201.3	181.3
32	23.8	21.4	92	68.3	61.5	52	112.9	101.7	12	157.5	141.8	72	202.1	182.0
33	24.5	22.1	93	69.1	62.2	53	113.7	102.4	13	158.2	142.5	73	202.8	182.6
34	25.3	22.7	94	69.8	62.9	54	114.4	103.0	14	159.0	143.2	74	203.5	183.3
35	26.0	23.4	95	70.6	63.6	55	115.1	103.7	15	159.7	143.8	75	204.3	184.0
36	26.7	24.1	96	71.3	64.2	56	115.9	104.4	16	160.5	144.5	76	205.0	184.6
37	27.5	24.8	97	72.1	64.9	57	116.6	105.0	17	161.2	145.2	77	205.8	185.3
38	28.2	25.4	98	72.8	65.6	58	117.4	105.7	18	161.9	145.8	78	206.5	186.0
39	29.0	26.1	99	73.5	66.2	59	118.1	106.4	19	162.7	146.5	79	207.3	186.6
40	29.7	26.8	100	74.3	66.9	60	118.9	107.0	20	163.4	147.2	80	208.0	187.3
41	30.5	27.4	101	75.0	67.6	161	119.6	107.7	221	164.2	147.8	281	208.7	188.0
42	31.2	28.1	02	75.8	68.2	62	120.3	108.4	22	164.9	148.5	82	209.5	188.7
43	31.9	28.8	03	76.5	68.9	63	121.1	109.0	23	165.7	149.2	83	210.2	189.3
44	32.7	29.4	04	77.3	69.6	64	121.8	109.7	24	166.4	149.9	84	211.0	190.0
45	33.4	30.1	05	78.0	70.2	65	122.6	110.4	25	167.1	150.5	85	211.7	190.7
46	34.2	30.8	06	78.7	70.9	66	123.3	111.0	26	167.9	151.2	86	212.5	191.3
47	34.9	31.4	07	79.5	71.6	67	124.1	111.7	27	168.6	151.9	87	213.2	192.0
48	35.7	32.1	08	80.2	72.3	68	124.8	112.4	28	169.4	152.5	88	213.9	192.7
49	36.4	32.8	09	81.0	72.9	69	125.5	113.1	29	170.1	153.2	89	214.7	193.3
50	37.1	32.5	10	81.7	73.6	70	126.3	113.7	30	170.9	153.9	90	215.4	194.0
51	37.9	34.1	111	82.5	74.3	171	127.0	114.4	231	171.6	154.5	291	216.2	194.7
52	38.6	34.8	12	83.2	74.9	72	127.8	115.1	32	172.3	155.2	92	216.9	195.3
53	39.4	35.5	13	83.9	75.6	73	128.5	115.7	33	173.1	155.9	93	217.7	196.0
54	40.1	36.1	14	84.7	76.3	74	129.3	116.4	34	173.8	156.5	94	218.4	196.7
55	40.9	36.8	15	85.4	76.9	75	130.0	117.1	35	174.6	157.2	95	219.1	197.4
56	41.6	37.5	16	86.2	77.6	76	130.7	117.7	36	175.5	157.9	96	219.9	198.0
57	42.3	38.1	17	86.9	78.3	77	131.5	118.4	37	176.1	158.5	97	220.6	198.7
58	43.1	38.8	18	87.7	78.9	78	132.2	119.1	38	176.8	159.2	98	221.4	199.4
59	43.8	39.5	19	88.4	79.6	79	133.0	119.7	39	177.5	159.9	99	222.1	200.5
60	44.6	40.1	20	89.1	80.2	80	133.7	120.4	40	178.3	160.6	300	222.9	200.8
Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.	Diff	Dep.	Lat.

for 48 Degrees.

Difference of Latitude and Departure for 43 Degrees.

Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	161.3
2	01.5	01.4	62	45.3	42.3	22	89.2	83.2	82	133.1	124.1	42	177.0	165.0
3	02.2	02.0	63	46.1	43.0	23	90.0	83.9	83	133.8	124.8	43	177.7	165.7
4	02.9	02.7	64	46.8	43.6	24	90.7	84.5	84	134.6	125.5	44	178.4	166.4
5	03.7	03.4	65	47.5	44.3	25	91.4	85.2	85	135.3	126.2	45	179.2	167.1
6	04.4	04.1	66	48.3	45.0	26	92.1	85.9	86	136.0	126.8	46	179.9	167.7
7	05.1	04.8	67	49.0	45.7	27	92.9	86.6	87	136.8	127.5	47	180.6	168.4
8	05.9	05.5	68	49.7	46.4	28	93.6	87.3	88	137.5	128.2	48	181.4	169.1
9	06.6	06.2	69	50.5	47.1	29	94.3	88.0	89	138.2	128.9	49	182.1	169.8
10	07.3	06.8	70	51.2	47.7	30	95.1	88.6	90	139.0	129.5	50	182.8	170.5
11	08.0	07.5	71	51.9	48.4	31	95.8	89.3	91	139.7	130.2	51	183.6	171.2
12	08.8	08.2	72	52.7	49.1	32	96.5	90.0	92	140.4	130.9	52	184.3	171.8
13	09.5	08.9	73	53.4	49.8	33	97.3	90.7	93	141.1	131.6	53	185.0	172.5
14	10.2	09.5	74	54.1	50.5	34	98.0	91.4	94	141.9	132.3	54	185.8	173.2
15	11.0	10.2	75	54.9	51.2	35	98.7	92.1	95	142.6	133.0	55	186.5	173.9
16	11.7	10.9	76	55.6	51.8	36	99.5	92.7	96	143.3	133.6	56	187.2	174.5
17	12.4	11.6	77	56.3	52.5	37	100.2	93.4	97	144.1	134.3	57	187.9	175.2
18	13.2	12.3	78	57.0	53.2	38	100.9	94.1	98	144.8	135.0	58	188.7	175.9
19	13.9	13.0	79	57.8	53.9	39	101.7	94.8	99	145.5	135.7	59	189.4	176.6
20	14.6	13.6	80	58.5	54.5	40	102.4	95.5	200	146.3	136.4	60	190.1	177.3
21	15.4	14.3	81	59.2	55.2	41	103.1	96.2	201	147.0	137.1	61	190.9	178.0
22	16.1	15.0	82	60.0	55.9	42	103.9	96.8	02	147.7	137.7	62	191.6	178.6
23	16.8	15.7	83	60.7	56.6	43	104.6	97.5	03	148.5	138.4	63	192.3	179.3
24	17.6	16.4	84	61.4	57.3	44	105.3	98.2	04	149.2	139.1	64	193.1	180.0
25	18.3	17.1	85	62.2	58.0	45	106.0	98.9	05	149.9	139.8	65	193.8	180.7
26	19.0	17.7	86	62.9	58.6	46	106.8	99.5	06	150.7	140.5	66	194.5	181.4
27	19.7	18.4	87	63.6	59.3	47	107.5	100.2	07	151.4	141.2	67	195.3	182.1
28	20.5	19.1	88	64.4	60.0	48	108.2	100.9	08	152.1	141.8	68	196.0	182.7
29	21.2	19.8	89	65.1	60.7	49	109.0	101.6	09	152.9	142.5	69	196.7	183.4
30	21.9	20.5	90	65.8	61.4	50	109.7	102.3	10	153.6	143.2	70	197.5	184.1
31	22.7	21.2	91	66.2	62.3	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	52	111.2	103.6	12	155.0	144.5	72	198.9	185.5
33	24.1	22.5	93	68.0	63.4	53	111.9	104.3	13	155.8	145.2	73	199.7	186.2
34	24.9	23.2	94	68.7	64.1	54	112.6	105.0	14	156.5	145.9	74	200.4	186.8
35	25.6	23.9	95	69.5	64.8	55	113.4	105.7	15	157.2	146.6	75	201.1	187.5
36	26.3	24.5	96	70.2	65.5	56	114.1	106.4	16	158.0	147.3	76	201.9	188.2
37	27.1	25.2	97	70.9	66.2	57	114.8	107.1	17	158.7	148.0	77	202.6	188.9
38	27.8	25.9	98	71.7	66.8	58	115.6	107.7	18	159.4	148.6	78	203.3	189.5
39	28.5	26.6	99	72.4	67.5	59	116.3	108.4	19	160.2	149.3	79	204.0	190.2
40	29.3	27.3	100	73.1	68.2	60	117.0	109.1	20	160.9	150.0	80	204.8	190.9
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	02	74.6	69.5	62	118.5	110.5	22	162.4	151.4	82	206.2	192.3
43	31.4	29.3	03	75.3	70.2	63	119.2	111.2	23	163.1	152.1	83	207.0	193.0
44	32.2	30.0	04	76.1	70.9	64	119.9	111.8	24	163.8	152.7	84	207.7	193.6
45	32.9	30.7	05	76.8	71.6	65	120.7	112.5	25	164.6	153.4	85	208.4	194.3
46	33.6	31.4	06	77.5	72.3	66	121.4	113.2	26	165.3	154.1	86	209.2	195.0
47	34.4	32.1	07	78.3	73.0	67	122.1	113.9	27	166.0	154.8	87	209.9	195.7
48	35.1	32.7	08	79.0	73.6	68	122.9	114.5	28	166.7	155.5	88	210.6	196.4
49	35.8	33.4	09	79.7	74.3	69	123.6	115.2	29	167.5	156.2	89	211.4	197.1
50	36.6	34.1	10	80.4	75.0	70	124.3	115.9	30	168.1	156.8	90	212.1	197.7
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.4
52	38.0	35.5	12	81.9	76.4	72	125.8	117.3	32	169.7	158.2	92	213.6	199.1
53	38.8	36.2	13	82.6	77.1	73	126.5	118.0	33	170.4	158.9	93	214.3	199.8
54	39.5	36.8	14	83.4	77.7	74	127.3	118.6	34	171.1	159.5	94	215.0	200.5
55	40.2	37.5	15	84.1	78.4	75	128.0	119.3	35	171.9	160.2	95	215.7	201.2
56	41.0	38.2	16	84.8	79.1	76	128.7	120.0	36	172.6	160.9	96	216.5	201.8
57	41.7	38.9	17	85.6	79.8	77	129.4	120.7	37	173.3	161.6	97	217.2	202.5
58	42.4	39.5	18	86.3	80.5	78	130.2	121.4	38	174.1	162.3	98	218.0	203.2
59	43.1	40.2	19	87.0	81.2	79	130.9	122.1	39	174.8	163.0	99	218.7	203.9
60	43.9	40.9	20	87.8	81.8	80	131.6	122.7	40	175.5	163.6	300	219.4	204.6
Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.	Dist	Dep.	Lat.

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for 47 Degrees.

Difference of Latitude and Departure for 44 Degrees.

Dift	Lat.	ep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.7	00.7	61	43.9	42.4	121	87.0	84.0	181	130.2	125.7	241	173.4	167.4
2	01.4	01.4	62	44.6	43.1	22	87.8	84.7	82	130.9	126.4	42	174.1	168.1
3	02.2	02.1	63	45.3	43.8	23	88.5	85.4	83	131.6	127.1	43	174.8	168.8
4	02.9	02.8	64	46.0	44.5	24	89.2	86.1	84	132.4	127.8	44	175.5	169.5
5	03.6	03.5	65	46.8	45.1	25	89.9	86.8	85	133.1	128.5	45	176.2	170.2
6	04.3	04.2	66	47.7	45.8	26	90.6	87.5	86	133.8	129.2	46	176.9	170.9
7	05.0	04.9	67	48.2	46.5	27	91.4	88.2	87	134.5	129.9	47	177.7	171.6
8	05.8	05.6	68	48.9	47.2	28	92.1	88.9	88	135.2	130.6	48	178.4	172.3
9	06.5	06.3	69	49.6	47.9	29	92.8	89.6	89	135.9	131.3	49	179.1	173.0
10	07.2	06.9	70	50.4	48.6	30	93.5	90.3	90	136.7	132.0	50	179.8	173.6
11	07.9	07.6	71	51.1	49.3	31	94.2	91.0	91	137.4	132.7	51	180.5	174.3
12	08.6	08.3	72	51.8	50.0	32	94.9	91.7	92	138.1	133.4	52	181.3	175.0
13	09.4	09.0	73	52.5	50.7	33	95.7	92.4	93	138.8	134.1	53	182.0	175.7
14	10.1	09.7	74	53.2	51.4	34	96.4	93.1	94	139.5	134.8	54	182.7	176.4
15	10.8	10.4	75	53.9	52.1	35	97.1	93.8	95	140.3	135.4	55	183.4	177.1
16	11.5	11.1	76	54.7	52.8	36	97.8	94.5	96	141.0	136.1	56	184.1	177.8
17	12.2	11.8	77	55.4	53.5	37	98.5	95.2	97	141.7	136.8	57	184.9	178.5
18	12.9	12.5	78	56.1	54.2	38	99.3	95.9	98	142.4	137.5	58	185.6	179.2
19	13.7	13.2	79	56.8	54.9	39	100.0	96.5	99	143.1	138.2	59	186.3	179.9
20	14.4	13.9	80	57.5	55.6	40	100.7	97.2	200	143.9	138.9	60	187.0	180.6
21	15.1	14.6	81	58.3	56.3	41	101.4	97.9	201	144.6	139.6	61	187.7	181.3
22	15.8	15.3	82	59.0	57.0	42	102.1	98.6	02	145.3	140.3	62	188.4	182.0
23	16.5	16.0	83	59.7	57.7	43	102.9	99.3	03	146.0	141.0	63	189.2	182.7
24	17.3	16.7	84	60.4	58.3	44	103.6	100.0	04	146.7	141.7	64	189.9	183.4
25	18.0	17.4	85	61.1	59.0	45	104.3	100.7	05	147.5	142.4	65	190.6	184.1
26	18.7	18.1	86	61.9	59.7	46	105.0	101.4	06	148.2	143.1	66	191.3	184.8
27	19.4	18.8	87	62.6	60.4	47	105.7	102.1	07	148.9	143.8	67	192.1	185.5
28	20.1	19.4	88	63.3	61.1	48	106.5	102.8	08	149.6	144.5	68	192.8	186.1
29	20.9	20.1	89	64.0	61.8	49	107.2	103.5	09	150.3	145.2	69	193.5	186.8
30	21.6	20.8	90	64.7	62.5	50	107.9	104.2	10	151.1	145.9	70	194.2	187.5
31	22.3	21.5	91	65.5	63.2	51	108.6	104.9	211	151.8	146.6	271	194.9	188.2
32	23.0	22.2	92	66.2	63.9	52	109.3	105.6	12	152.5	147.3	72	195.6	188.9
33	23.7	22.9	93	66.9	64.6	53	110.1	106.3	13	153.2	147.9	73	196.4	189.6
34	24.5	23.6	94	67.6	65.3	54	110.8	107.0	14	153.9	148.6	74	197.1	190.3
35	25.2	24.3	95	68.3	66.0	55	111.5	107.7	15	154.6	149.3	75	197.8	191.0
36	25.9	25.0	96	69.1	66.7	56	112.2	108.4	16	155.4	150.0	76	198.5	191.7
37	26.6	25.7	97	69.8	67.4	57	112.9	109.1	17	156.1	150.7	77	199.2	192.4
38	27.3	26.4	98	70.5	68.1	58	113.1	109.7	18	156.8	151.4	78	200.0	193.1
39	28.1	27.1	99	71.2	68.8	59	114.4	110.4	19	157.5	152.1	79	200.7	193.8
40	28.8	27.8	100	71.9	69.5	60	115.1	111.1	20	158.2	152.8	80	201.4	194.5
41	29.5	28.5	101	72.6	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	02	73.4	70.9	62	116.5	112.5	22	159.7	154.2	82	202.8	195.9
43	30.9	29.9	03	74.1	71.5	63	117.2	113.2	23	160.4	154.9	83	203.6	196.6
44	31.6	30.6	04	74.8	72.2	64	118.0	113.9	24	161.1	155.6	84	204.3	197.3
45	32.4	31.3	05	75.5	72.9	65	118.7	114.6	25	161.8	156.3	85	205.0	198.0
46	33.1	32.0	06	76.2	73.6	66	119.4	115.3	26	162.6	157.0	86	205.7	198.7
47	33.8	32.6	07	77.0	74.3	67	120.1	116.0	27	163.3	157.7	87	206.4	199.3
48	34.5	33.3	08	77.7	75.0	68	120.8	116.7	28	164.0	158.4	88	207.2	200.0
49	35.2	34.0	09	78.4	75.7	69	121.6	117.4	29	164.7	159.1	89	207.9	200.7
50	36.0	34.7	10	79.1	76.4	70	122.3	118.1	30	165.4	159.8	90	208.6	201.4
51	36.7	35.4	111	79.8	77.1	71	123.0	118.8	231	166.2	160.4	291	209.3	202.1
52	37.4	36.1	12	80.6	77.8	72	123.7	119.5	32	166.9	161.1	92	210.0	202.8
53	38.1	36.8	13	81.3	78.5	73	124.4	120.2	33	167.6	161.8	93	210.8	203.5
54	38.8	37.5	14	82.0	79.2	74	125.2	120.9	34	168.3	162.5	94	211.5	204.2
55	39.6	38.2	15	82.7	79.9	75	125.9	121.6	35	169.0	163.2	95	212.2	204.9
56	40.3	38.9	16	83.4	80.6	76	126.6	122.2	36	169.8	163.9	96	212.9	205.6
57	41.0	39.6	17	84.2	81.3	77	127.3	122.9	37	170.5	164.6	97	213.6	206.3
58	41.7	40.3	18	84.9	82.0	78	128.0	123.6	38	171.2	165.3	98	214.4	207.0
59	42.4	41.0	19	85.6	82.7	79	128.8	124.3	39	171.9	166.0	99	215.1	207.7
60	43.1	41.7	20	86.3	83.4	80	129.5	125.0	40	172.6	166.7	300	215.8	208.4
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 46 Degrees.

Difference of Latitude and Departure for 45 Degrees.

Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.	Dift	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	22	86.3	86.3	82	128.7	128.7	42	171.1	171.1
3	02.1	02.1	63	44.5	44.5	23	87.0	87.0	83	129.4	129.4	43	171.8	171.8
4	02.8	02.8	64	45.3	45.3	24	87.7	87.7	84	130.1	130.1	44	172.5	172.5
5	03.5	03.5	65	46.0	46.0	25	88.4	88.4	85	130.8	130.8	45	173.2	173.2
6	04.2	04.2	66	46.7	46.7	26	89.1	89.1	86	131.5	131.5	46	173.9	173.9
7	04.9	04.9	67	47.4	47.4	27	89.8	89.8	87	132.1	132.1	47	174.6	174.6
8	05.7	05.7	68	48.1	48.1	28	90.5	90.5	88	132.9	132.9	48	175.4	175.4
9	06.4	06.4	69	48.8	48.8	29	91.2	91.2	89	133.6	133.6	49	176.1	176.1
10	07.1	07.1	70	49.5	49.5	30	91.9	91.9	90	134.3	134.3	50	176.8	176.8
11	07.8	07.8	71	50.2	50.2	31	92.6	92.6	91	135.1	135.1	51	177.5	177.5
12	08.5	08.5	72	50.9	50.9	32	93.3	93.3	92	135.8	135.8	52	178.2	178.2
13	09.2	09.2	73	51.6	51.6	33	94.0	94.0	93	136.5	136.5	53	178.9	178.9
14	09.9	09.9	74	52.3	52.3	34	94.7	94.7	94	137.2	137.2	54	179.6	179.6
15	10.6	10.6	75	53.0	53.0	35	95.5	95.5	95	137.9	137.9	55	180.3	180.3
16	11.3	11.3	76	53.7	53.7	36	96.2	96.2	96	138.6	138.6	56	181.0	181.0
17	12.0	12.0	77	54.4	54.4	37	96.9	96.9	97	139.3	139.3	57	181.7	181.7
18	12.7	12.7	78	55.2	55.2	38	97.6	97.6	98	140.0	140.0	58	182.4	182.4
19	13.4	13.4	79	55.9	55.9	39	98.3	98.3	99	140.7	140.7	59	183.1	183.1
20	14.1	14.1	80	56.6	56.6	40	99.0	99.0	200	141.4	141.4	60	183.8	183.8
21	14.8	14.8	81	57.3	57.3	41	99.7	99.7	201	142.1	142.1	61	184.5	184.5
22	15.6	15.6	82	58.0	58.0	42	100.4	100.4	02	142.8	142.8	62	185.3	185.3
23	16.3	16.3	83	58.7	58.7	43	101.1	101.1	03	143.5	143.5	63	186.0	186.0
24	17.0	17.0	84	59.4	59.4	44	101.8	101.8	04	144.2	144.2	64	186.7	186.7
25	17.7	17.7	85	60.1	60.1	45	102.5	102.5	05	144.9	144.9	65	187.4	187.4
26	18.4	18.4	86	60.8	60.8	46	103.2	103.2	06	145.7	145.7	66	188.1	188.1
27	19.1	19.1	87	61.5	61.5	47	103.9	103.9	07	146.4	146.4	67	188.8	188.8
28	19.8	19.8	88	62.2	62.2	48	104.6	104.6	08	147.1	147.1	68	189.5	189.5
29	20.5	20.5	89	62.9	62.9	49	105.4	105.4	09	147.8	147.8	69	190.2	190.2
30	21.2	21.2	90	63.6	63.6	50	106.1	106.1	10	148.5	148.5	70	190.9	190.9
31	21.9	21.9	91	64.3	64.3	51	106.8	106.8	21	149.2	149.2	71	191.6	191.6
32	22.6	22.6	92	65.1	65.1	52	107.5	107.5	12	149.9	149.9	72	192.3	192.3
33	23.3	23.3	93	65.8	65.8	53	108.2	108.2	13	150.6	150.6	73	193.0	193.0
34	24.0	24.0	94	66.5	66.5	54	108.9	108.9	14	151.3	151.3	74	193.7	193.7
35	24.7	24.7	95	67.2	67.2	55	109.6	109.6	15	152.0	152.0	75	194.4	194.4
36	25.5	25.5	96	67.9	67.9	56	110.3	110.3	16	152.7	152.7	76	195.2	195.2
37	26.2	26.2	97	68.6	68.6	57	111.0	111.0	17	153.4	153.4	77	195.9	195.9
38	26.9	26.9	98	69.3	69.3	58	111.7	111.7	18	154.1	154.1	78	196.6	196.6
39	27.6	27.6	99	70.0	70.0	59	112.4	112.4	19	154.8	154.8	79	197.3	197.3
40	28.3	28.3	100	70.7	70.7	60	113.1	113.1	20	155.6	155.6	80	198.0	198.0
41	29.0	29.0	101	71.4	71.4	61	113.8	113.8	21	156.3	156.3	281	198.7	198.7
42	29.7	29.7	02	72.1	72.1	62	114.5	114.5	22	157.0	157.0	82	199.4	199.4
43	30.4	30.4	03	72.8	72.8	63	115.3	115.3	23	157.7	157.7	83	200.1	200.1
44	31.1	31.1	04	73.5	73.5	64	116.0	116.0	24	158.4	158.4	84	200.8	200.8
45	31.8	31.8	05	74.2	74.2	65	116.7	116.7	25	159.1	159.1	85	201.5	201.5
46	32.5	32.5	06	74.9	74.9	66	117.4	117.4	26	159.8	159.8	86	202.2	202.2
47	33.2	33.2	07	75.7	75.7	67	118.1	118.1	27	160.5	160.5	87	202.9	202.9
48	33.9	33.9	08	76.4	76.4	68	118.8	118.8	28	161.2	161.2	88	203.6	203.6
49	34.6	34.6	09	77.1	77.1	69	119.5	119.5	29	161.9	161.9	89	204.3	204.3
50	35.4	35.4	10	77.8	77.8	70	120.2	120.2	30	162.6	162.6	90	205.1	205.1
51	36.1	36.1	11	78.5	78.5	71	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	12	79.2	79.2	72	121.6	121.6	32	164.0	164.0	92	206.5	206.5
53	37.5	37.5	13	79.9	79.9	73	122.3	122.3	33	164.7	164.7	93	207.2	207.2
54	38.2	38.2	14	80.6	80.6	74	123.0	123.0	34	165.5	165.5	94	207.9	207.9
55	38.9	38.9	15	81.3	81.3	75	123.7	123.7	35	166.2	166.2	95	208.6	208.6
56	39.6	39.6	16	82.0	82.0	76	124.4	124.4	36	166.9	166.9	96	209.3	209.3
57	40.3	40.3	17	82.7	82.7	77	125.2	125.2	37	167.6	167.6	97	210.0	210.0
58	41.0	41.0	18	83.4	83.4	78	125.9	125.9	38	168.3	168.3	98	210.7	210.7
59	41.7	41.7	19	84.1	84.1	79	126.6	126.6	39	169.0	169.0	99	211.4	211.4
60	42.4	42.4	20	84.8	84.8	80	127.3	127.3	40	169.7	169.7	300	212.1	212.1
Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.	Dift	Dep.	Lat.

for 45 Degrees.

**SOUTH COAST of England, bounding the British Channel,
and the opposite Coast of France; with the Latitudes and
Longitudes, and Time of High Water, and the Time
the Current runs in the Offing of some Places.**

English Coast.	H.W. H.M.	Lat. D.M.	Long. D.M.	French Coast.	H.W. H.M.	Lat. D.M.	Long. D.M.
North Foreland	10 30	51 25 N	1 34 E.	Dunkirk	12 0	51 5 N	2 27 E.
Ramsgate	10 30	51 20	1 30	Graveline	11 43	51 0	2 12
Deal	10 30	51 14	1 30	Calais	11 30	50 57	1 56
The Downs	10 30	51 25	1 35	Cape Crifnez	11 30	50 50	1 40
South Foreland	10 30	51 12	1 30	Boulogne	10 30	50 43	1 42
Dover	10 30	51 7	1 22	Abbeville	10 30	50 7	1 56
Rye	11 15	51 3	0 50	Dieppe	10 30	49 57	1 9
Dungeness	9 45	50 57	0 6	Havre de Grace	9 0	49 33	0 17
Hastings	10 15	50 52	1 34	Rouen up R. Sein	1 15	49 27	1 15
Beachy Head	9 55	50 48	0 20	Sein R. Mouth	9 0	49 30	0 10
Brightelmstone	9 55	50 50	0 0 W	Caen	9 0	49 11	0 16 W
Arundel	9 45	50 50	0 30	C. Barfleur	7 30	49 40	1 12
Shoreham	9 45	50 51	0 15	Cherburg	7 10	49 38	1 34
The Owers	9 15	50 39	0 40	C. de la Hogue	12 0	49 45	1 55
Chichester Harbour	11 30	50 47	0 55	Coutance	6 0	49 2	1 30
Portsmouth	11 15	50 48	1 4	Granville	6 0	48 50	1 36
Spithead Road	9 30	50 48	1 6	Avranches	6 0	48 41	1 24
Cowes I. of Wight	10 45	50 48	1 16	St. Malo	6 0	48 39	1 57
St. Helen's Road	9 0	50 43	0 55	Seven Islands	0 0	48 48	3 25
Bembridge, I. Wi.	10 15	50 40	0 52	Ile de Bas	3 45	48 45	3 55
Dunnofe	9 15	50 35	1 21	Ushant	5 15	48 30	4 59
Catharine's Point	8 35	50 34	1 14	Brest	3 45	48 23	4 26
Needles 10h. 15m.	9 30	50 42	1 34				
Christ Church	8 35	50 46	1 44				
Pool, Dorsetshire	9 0	50 46	1 54				
Peveral Point	8 45	50 36	1 50				
St. Alban's Head	8 30	50 35	2 0				
Weymouth	7 30	50 38	2 30				
Bill of Portland	7 15	50 31	2 30				
Exmouth Bar	6 30	50 38	3 30				
Exeter	0 0	50 45	3 39				
Torbay	5 15	50 28	3 38				
Dartmouth	5 15	50 25	3 36				
Start Point	6 10	50 6	3 45				
Prall, S.P. of Dev	6 10	50 15	3 53				
Plymouth	6 15	50 25	4 20				
Eddystone	5 45	50 9	4 19				
Ram Head	6 0	50 21	4 20				
Falmouth	5 20	50 10	5 12				
Lizard Point	4 30	49 57	5 14				
Mount's Bay	5 0	50 5	5 45				
Land's End	4 30	50 6	6				
Scilly I.	3 45	50 6	6 49				
St. Marie's I.	3 45	49 58	6 40				
Aldern. & Caskets	12 0	49 48	2 10				
Guern. I. & Sark I.	1 30	49 30	2 47				
Jersey I.	0 30	49 7	2 6				
St. Agnes' Light H.		49 56	6 41				

The Current in the Mid. Channel in N. E. about 1 H. 30 M. after High Water; and it runs off Dungeness 4 H. to 4 and an Half Hours; in the Downs 4 Hours; and East in the King's Channel, 3 Hours after High Water

The following Table shews the Time of High Water at the principal Headlands, &c. in the Channel, on Full and Change Days, and the Time the Current runs after High Water.

The Current runs after H.W.			
High Water.	H.M.	H.M.	H.M.
At the Lizard at	4 30	3 0	7 30
Off the Eddystone	5 30	3 0	8 30
Off the Start	6 10	2 30	8 30
Off Portland	7 15	3 0	10 15
Off I. of Wight	8 14	3 15	11 30
Off Arundel	9 15	1 15	10 30
and Shoreham	9 15	1 15	10 30
Off Beachy	9 45	1 15	11 0
Off Dungeness	10 30	4 0	2 30

Note, H. W. stands for High Water; R. for River; I. for Island; P. for Point; and C. for Cape.—The Longitude is reckoned from the Meridian of London.

NOTE. The Variation in the English, St. George's Channels, and on the East Coast of England is about 24 Degrees West, and about the Orkneys and Shetland Islands about 2 Points, one the Western Coast of Ireland 24° West, and is found to vary between 11 and 12 Minutes Westward every Year, or a Degree in about 5 $\frac{1}{2}$ Years, therefore, by adding a Degree for every 5 $\frac{1}{2}$ Years to the Variation here given for 1784, you will have the Variation nearly for any succeeding year.

*From Land's End Westward
round the Coast of Great
Britain.*

	H.W.	Lat.	Long.
	H.M.	D.M.	D.M.
Land's End	4 30	50 6	6 0 W
C. Cornwall	4 30	50 10	5 50
St. Ives Bay	5 0	50 8	5 22
Hartland Point	4 33	51 3	4 30
Lundy Island	5 15	51 13	4 50
Barnstaple		51 6	4 24
Boggy Point	5 20	51 10	4 27
Morte Point		51 13	4 25
Foreland Point		51 16	4 1
King's Road	6 50	51 29	2 50
Bristol	7 4	51 29	2 40
Caldy Isle	5 30	51 37	4 50
Swansea	6 0	51 40	4 1
Milford Haven light House	6 0	51 45	5 0
Smalls Light House	9 0	51 45	5 14
St. Bride's Bay	9 0	51 48	5 6
St. David's Head	6 6	51 55	5 10
Newport	7 0	52 0	4 55
Bardsey Isle	8 30	52 58	4 50
Carnarvon	8 30	53 6	4 30
Holyhead N. Point	9 45	53 17	4 46
Skerries Light House	9 45	53 24	4 44
Chester Bar	10 30	53 12	3 7
Liverpool	11 15	53 22	3 12
Lancaster	11 15	54 5	3 0
Carlisle	11 15	54 55	3 0
Kirkcudbright	11 0	54 45	3 53
St. Bee's Head Light House	10 45	54 31	3 38
Edinburgh	4 30	55 58	3 12
Mull of Galloway	11 0	54 39	5 0
Arran Isle	11 0	55 30	5 45
Mull of Cantire	10 30	55 17	6 0
Lewis's, S. Point		56 48	7 54
Lewis's, N. Point		58 37	6 54
Dungby Head		58 45	3 6
Tarbet Nefs		57 50	3 36
Peter Head or Buch- anefs	3 0	57 30	1 34
Aberdeen	0 45	57 6	2 0
Fife Nefs		56 15	2 37
May Isle Light House	4 30	55 10	2 37
St. Abb's Head	2 30	55 54	1 58
Berwick	2 30	55 47	1 50
Holy Island	2 30	55 41	1 38 W
Staples	2 30	55 39	1 30
Sunderland Point	2 30	55 35	1 32
Coquet Isle	2 30	55 22	1 21
Tinmouth Castle	3 0	55 3	1 8
Tinmouth Lights		55 3	1 8
Sunderland	3 0	54 56	1 8
Hartlepool	3 30	54 45	1 2
Tees' Mouth	3 30	54 41	0 56
Whitby	3 45	54 33	0 26
Robinhood's Bay	3 45	54 29	0 22
Scarborough	4 30	54 20	0 10
Flamborough Head	4 30	54 11	0 8 E
Bridlington Bay		54 9	0 3
Spurn Head Lights	5 30	53 38	0 27
Boston Harbour	6 0	53 0	0 35
Dudgeon Lights	8 0	53 20	1 15
Cromer	9 0	52 59	1 27

	H.W.	Lat.	Long.
	H.M.	D.M.	D.M.
Foulness Light House	9 0	52 59	1 29 W
Winterton Lights	9 45	52 49	1 50
Yarmouth	9 30	52 45	1 50
Leostoff 10	9 0	52 36	1 52
Leostoff Light House		52 48	
Sole Bay	9 30	52 24	1 50
Orfordness	9 45	52 10	1 20
Harwich 10 h. 30m.	11 15	52 0	1 20
Ipswich 11	11 0	52 8	1 15
The Cur. runs till	1 0		
Kentish Knock			
the Eastermost			
Sand in the	10 30		1 40
King's Chan- nel, N. of the			
Downs.			
King's Channel			
along the Swin	10 30	51 38	1 16
Runs	12 0		
Margate	11 0	51 25	1 20
The Nore	12 0	51 34	1 6
Sheerness	12 0	51 31	0 50
R. Medway, Ro- chester and Cha- tham	0 45	51 25	0 36
Gravesend	1 30	51 23	0 25
R. Thames London	2 46	51 32	0 0

Isle of Man.

Calf of Man	10 30	54 1	4 38
Douglas	10 30	54 7	4 24
Ramfay Bay	10 30	54 17	4 21
Point Ayre	10 30	54 25	4 21
Peel Hill	10 30	54 12	4 35
Variation 24° West.			

The Orkney Isles.

Pentland Skerries Isle	11 0	58 36	3 1 W
Old Head, S. Point of Orkney I.	11 0	58 40	3 0
Ronaldsha N. Point of Ditto	10 30	59 22	2 30

Shetland Isles.

Fair Isle	4 0	59 30	1 38 W
Foul Isle	3 0	60 12	1 20
S. Point of the Shet- land Isles	3 0	59 54	1 50
Lambo Nefs N. P. of Ditto Isles	4 0	61 15	2 6
West Faro Islands		62 0	6 30
Rockal, looks like an Hay Stack		57 22	10 30

The Coast of Ireland.

Old Head Kinfaie		51 31 W	8 47
Kinfaie Harbour		51 35	8 46
Cork Harbour		51 42	8 35
Youghall Bay		51 52	8 17
Dungarvon Bay		52 1	7 45
Waterford Haven	5 0	52 3	7 43
Saltees Rocks	5 30	52 3	7
Cernfore Point		52 11	6 51
Tusker Rocks		52 11	6 45
Wexford Bay		52 21	6 52

	H. W. H. M.	Lat. D. M.	Long. D. M.
Mizen Head		52 52 N.	6 39 W
Wicklow Lighthouse		52 58	6 38
Codlingridge Buoys		53 8	6 32
Dublin Bay	10 30	53 20	6 43
Hoth Lighthouse		53 22	6 41
Lambay Island		53 28	6 40
St. Patrick's Island		53 35	6 35
Drogheda Bar		53 44	6 42
Dundalk Bay		53 57	6 42
Carlingford Bay		54 0	6 37
Newry		54 5	6 42
Strangford Bay		54 17	6 15
Mew Lighthouse		54 41	6 4
Belfast	10 15	54 40	6 20
Larn Harbour		54 53	6 14
The Maids off Ditto		54 58	6 12
Fair Head		55 15	6 30
Raughlan Island	10 15	55 20	6 36
Fortruth		55 15	7 0
Seven Heads	3 0	51 36	8 22
Cape Clear Westward	3 15	51 18	9 46
Faifnet Rock	3 0	52 13	9 51
Crook Haven	3 0	51 19	9 55
Mizen Head	3 0	51 17	10 1
Dun Manus Bay		51 28	10 1
Sheep's Head	3 0	51 24	10 2
Bantree Bay		51 26	10 2
The Cow and Calf		51 26	10 22
Kennere River	3 0	51 37	10 14
The Skelling Rocks		51 40	10 34
The Blaskets		51 58	10 36
Ballinskellings Bay	3 15	51 42	9 14
Bray Head	3 30	51 47	10 30
Dingle Bay	3 30	51 55	10 26
Ferriters Isles	3 30	51 55	10 36
Smeriwick Harbour	3 30	52 5	10 28
Brandon Head Bay		52 10	10 23
Carry Head		52 15	10 13
Loop Head, or Mouth of River Shannon	3 45	52 23	10 14
Galloway Bay	6 30	53 10	9 30
Sline Head	7 0	53 20	10 40
Black Rocks		53 55	10 47
Broad Haven	7 0	54 6	10 38
Donnegall Bay		54 30	8 45
Cape Telling		54 38	9 23
Tory Island		55 9	8 50
North Cape		55 15	8 30
Entrance of London- derry Lough	7 30	55 12	7 30
Mouth of the Bann River		55 10	7 17
Carrickfergus Bay		54 45	6 10

West Coast of France.

Isle of Ushant	5 13	48 30 N	4 59 W
Brest	3 45	48 23	4 26
Penmark Point	3 0	47 50	4 20
Belle Isle	3 30	47 21	3 13
Angers	0 0	47 28	0 34
Rochelle	3 45	46 10	1 11
Nantz	0 0	47 13	1 30
Bordeaux	3 0	44 50	0 30
Bayonne	3 30	43 29	1 25

West Coast of Spain and Portugal.

Cape Ortegal	3 0	43 47 N	7 34 W
Cape Pinas	3 0	43 51	5 47
C. Corunna	3 0	43 56	9 10
C. Prior	0 0	43 38	8 25
C. Finisterre	3 15	42 52	9 13
Ville del Conde		41 11	8 20
Oporta, or Porta Port	3 15	41 10	8 22
Bayonna	4 45	42 3	8 45
Burlings		39 30	9 20
Lisbon	2 45	38 42	9 3
C. Roxent	1 0	38 46	9 30
C. St. Vincent		37 2	8 45
Cadiz 6	4 30	36 31	6 13
Cape Trefalgar		36 10	5 53
Gibraltar	2 0	36 6	4 53

The Coasts on the Main Conti- nent within the Straits.

Places Names.	Lat. D. M.	Long. D. M.
Malaga	36 42 N	4 0 W
Cape de Gat	36 40	1 40
Cape Paul	38 15	0 1
Alicant	38 35	0 15
Cape St. Martin	38 46	0 30 E
Valencia	39 35	0 0
Barcelona	41 26	2 18
Marseilles	43 18	5 27
Toulon	43 17	6 3
Genoa	44 25	8 40
Leghorn	43 28	10 30
Civita Vecchia	42 5	11 51
Rome	41 54	12 34
Naples	40 51	14 20
Cape Spartevento	37 55	16 45
Cape Colonne	38 56	18 1
Gallipoli	40 23	18 23
Cape St. Maria, or Lucia	39 45	19 0
Ancona	43 40	13 30
Venetio, or Venice	45 25	12 4
Zara	44 30	16 35
Ragusa	42 10	18 50
Cattaro	42 47	19 17
La Valona	40 35	21 15
Lepanto	38 20	22 42
Cape Matapan, or Caliga	36 33	22 41
Cape St. Angelo, or Angulo	36 32	23 56
Athens	38 58	24 5
Cape Martelo South Point of Negropont	38 7	25 3
Cape Colom, or Colonne	37 45	24 42
Salonica	40 41	23 13
Cape Monte Sancto	40 26	25 2
Gallipoli	40 53	27 20
Constantinople	41 1	28 57
Cape Barbador, or Baba	39 30	26 30
Smyrna	38 28	27 25
Cape Barbernola, or Blane	38 9	26 32
Ephesus	38 1	27 53
Antiochetta	36 10	36 17
Scanderoon; or Alexan- dretta	36 34	36 26

Places Names.	Lat. D. M.	Long. D. M.		Lat. D. M.	Long. D. M.
Antioch	36 11N.	36 18 E.	Melada	42 52N.	18 6E.
Aleppo	35 42	37 24	Corfu	39 42	29 46
Tortofa	35 4	36 20	Cephalonia	38 15	20 10
Tripoli	34 48	36 5	Zante	37 46	21 14
Joppa, or Jaffa	32 45	36 0	Sapienza	30 46	21 45
Jerusalem	31 51	35 25	<i>Islands in the Archipelago.</i>		
Alexandria	31 10	30 19	Taffo	40 40	25 17E.
Cape Rufata	32 41	21 25	Lemnos	39 59	25 37
Cape Mesurata	32 21	16 17	Metyline { Cape Sygre	39 15	26 5
Tripola	32 54	13 10	{ P. Olivia	38 57	27 0
Sufa	35 53	10 34	Siatto, or Schate	39 22	23 58
Cape Bona	37 3	11 4	Scio, or Xio	38 22	26 12
Tunis	36 50	10 17	Patmos	37 20	26 55
Bona	37 5	8 19	Tino	37 35	25 36
Seven Capes	37 15	7 0	Zio, or Sea	37 37	24 50
Gigeri	37 14	6 15	Ferminia, Fermina, or		
Cape Tidelles, or Delly's	37 15	4 18	Termie	37 24	24 58
Algier	36 50	2 19	Serfante, or Sifanto	36 58	25 20
Cape Tenes	36 45	1 50	Milo	36 40	25 0
Oran	36 2	0 26	W. { End of		
Cape Tres Forcas	35 30	2 4W	E. { Cania.		
Ceuta	35 54	4 45	{ Cape St. John	35 10	24 0
Tangier	35 52	5 45	{ Cape Solom.	35 0	27 8
<i>Islands within the Straits.</i>			Rhodes { N. End of Cape	36 27	28 28
Alboram	36 0N.	2 27E.	{ S. End Tranquil	35 52	28 28
Formentaria	38 33	1 15	S.W. { End of		
Ivica	38 50	1 39	E. { Cyprus.		
Majorca	39 29	2 35	{ C. Baffa	34 57	32 23
Minorca	39 51	4 0	East. { End of		
C. Tolare, So. { End of	38 50	9 12	Sout. { Cyprus.		
C. Reperade N. { Sardin.	41 10	9 50	{ C. St. Andr.	35 31	35 0
Afinaria	41 3	8 48	{ C. de Cattel	34 30	33 10
Bonifacio, So. { End of	41 24	9 46	<i>Coast of Greenland.</i>		
C. Corfo, Nor. { Corfica	42 56	9 50		H.W.	
Caprya	43 3	10 17	Nova Sem. and Isles		
Liboa, or Elba	42 45	10 40	Shetland S. Point.	59 56N	1 30W
M. Christo	42 17	11 0	North ditto	3 0	60 50
Palморalla, or Palmeria	41 3	13 5	Hangcliff	Var.	0 10
Ponza	41 0	13 7	Entr. of Brazy S.	23 45	60 9
Ischia, or Eschia	40 34	13 35			0 38
Liffa	43 6	15 40	<i>Coast of Iceland.</i>		
Agoffa	42 58	17 20	Sound Royal	66 22	14 30W
Corcola	43 3	17 32	Bargazar Point	66 20	16 32
Strombello	38 58	16 0	Whale's Back	65 26	20 32
Volcano	38 27	15 33	Merchant's Forel	63 24	17 5
Telicur	38 35	15 0	Halliford	64 30	27 20
Allicur	38 36	14 42	Fair Foreland	66 18	26 30
Uttica	38 36	13 32	Grim's Islands	67 13	22 32
Trepano W. End of	37 57	13 13	Westmonia Isles	63 28	22 22
Palermo	38 6	13 50	Isles of Ferre, or		
C. Passero E. End of	36 38	15 40	Farro	62 4	5 0
Messina in	38 38	16 20	Beerenburg, or Joan		
Syracuse in	37 7	15 45	Main Isle	71 33	4 30
Pantaloria	36 48	12 30	<i>Coast of Greenland.</i>		
Limofa	35 56	13 11	Point Look-out	Var.	76 24
Lampidofa	35 34	12 46	Horn Sound	West.	76 45
Malta	35 53	14 32	Bell Sound		77 12
Ouvre Poel, a Rock	35 45	16 36	Charles I. Black		77 30
			Point		11 15

		Lat. D.M.	Long. D.M.	Wybourg	60 50N	29 12 E
C. Cold N. end	Va.W			Peterburg	59 56	30 25
Charles I.	18 36	79 6	11 2 E	Memel	55 55	21 15
Isle Amsterdam		79 40	12 45	Narva	59 15	28 20
Fair Foreland		79 18	10 50	Demes Nefs Lights	57 39	22 21
Hacluit's Headland	17 40	79 49	10 46	Koningsberg	54 40	21 53
Cloven Cliff	18 24	79 43	9 56	Dantzic	54 22	18 36
Muffin Isle	18 13	80 19	11 20	Bornholm	55 12	14 40
Black Point	9 42	78 28	18 38	Srael Sound	54 24	13 10
Table I. one of the				Lubec	54 4	11 40
Seven	9 33	80 57	20 34	Anout	56 40	12 0
Smeerenburg	18 53	79 44	11 48	Lefon	57 4	11 9
Dunkin's Isle in Vo-	18 47	79 42	9 59	Riga	57 0	25 10
gel Sound	20 38	79 52	12 30	Dogoret Lights	58 56	22 35
Hope Island		76 15	23 40	Koxcar Lights	59 43	25 43
Cherry, or Bear Isle		74 28	18 0			
Admiralty Isle		75 0	54 40			

Coast of Holland and Flanders.

From Wiegate Straits to the Naze.

Nova Sembla	78 0 N	70 0 E
Wiegate Straits	69 30	02 2
Cape Candinofe	68 45	43 15
Cape Bars	66 30	41 50
Cat Nose	65 27	38 30
Archangel	64 34	38 58
Cape Bona Fortuna	66 0	40 48
Crofs Island	66 25	40 8
Sweetnose	68 7	39 54
RiverKola Entrance	69 30	35 35
Kilduyn I.	69 34	35 45
Fisher's I.	70 27	33 25
North Cape	71 10	26 15
Surroy	71 7	23 8
Tromfound I.	69 20	18 40
Samien I. S. W. Pt.	69 35	16 15
Lefort, S. W. Pt.	68 35	11 12
Werro, Island	67 43	9 15
Drontheim	63 26	11 10
Kate Nefs	61 25	6 0
Hearle, S. end	60 15	6 1
North Bergen	60 10	6 10
Bommel I. N. Pt.	59 25	6 2
Whiting-eye Lights	59 5	6 12
Judder	58 25	6 5
TheNaze of Norway	57 59	7 15
Ferder Lights	58 25	10 3
Christiana	59 42	10 7

Scaw	H.W.	57 38	10 20
Helighland		54 17	9 3
Bremen	6 0	53 30	9 0
Hamburgh	6 15	53 36	9 55
Embden	12 15	53 13	7 15
The Texel	7 30	53 5	4 43
Amsterdam	3 0	52 22	4 50
Antwerp	6 0	51 13	4 28
The Brill	1 30	51 55	4 2
Ottend	12 0	51 13	3 1

The Western Isles.

Corvo	39 41N	31 0W
Flores	39 34	30 55
Fial	38 32	28 41
Tercera	38 39	27 6
St. George's	38 39	27 55
Pico, or Pic of A-		
zores	38 30	28 20
St. Michael's	37 49	25 36
St. Mary's	37 0	25 6

Canary Islands.

Porto Sancto	32 58N	16 28W
Madeira East End	32 50	16 26
Funchal	12 0	32 38
Ditto West End	32 30	17 26
Palma	28 37	17 45
Teneriff the Pic	28 13	16 23
Gomera	28 6	17 8
Fero, or Isle of Fer	27 48	17 45
Canaria, N. E. Pt.	28 13	17 33
I. Fortune Ventura	28 14	14 26
seven others N. E.		
of this	28 5	

Coast in the Sound and Baltic.

Koll Lights	56 19	12 43
Elfinore	56 3	12 4
Copenhagen	55 41	12 46
Falsterbo Lights	55 25	12 54
Kalemer	56 40	16 30
Bornholm, I. N. Pt.	55 22	14 40
Stockholm	59 21	18 9
Gotland S. Point	56 56	18 34

Cape de Verd Islands.

St. Anthony, N. E. Pt.	17 9N	24 48W
St. Vincent's, S. P.	16 45	24 59
St. Lucia, S. Pt.	16 40	24 35
St. Nicholas, E. P.	16 19	24 2
Isle of Sel, S. Pt.	16 30	22 52
Bonavista, English Road	16 5	23 5
Isle of May	15 10	23 5
Isle of St. Jago, E. Pt.	14 54	23 26
Isle of Brava	14 45	24 42
Bermudas, N. P.	32 35	63 28
Ditto, St. George's	32 25	63 40

Islands in the West Indies.

Barbadoes, N. End	13 22½	59 52W
South Pt. ditto	13 7	59 45
East Pt. ditto	13 12½	59 37
Bridge Town ditto	13 9½	59 51
Tobago, N. E. Pt.	11 21½	60 8½
Plymouth Town, ditto	11 10½	60 27
Sandy Pt. ditto	11 6	60 32½
Trinidad, N. E. Pt.	10 20	59 32
S. W. P. ditto	9 34	61 10
N. W. Pt. Bay de la Sierra	10 10	60 30
St. Lucia, N. Pt.	13 56	60 46
S. E. Pt. ditto	13 27	60 45
S. W. Pt. ditto	13 30	61 0
Martinico, N. W. Pt.	14 51	61 26½
Fort Royal, ditto	14 36	61 4
S. W. Pt. ditto, or Diamond Rock	14 24½	61 1
S. E. Pt. ditto, or Saline Pt.	14 24	60 57
Carvel Isle	14 58½	61 2
Granada, N. Pt.	12 23	61 47½
S. W. Pt. ditto, or Salines Pt.	12 2	61 58
Fort Royal, ditto	12 6½	61 50
St. Vincent's, N. Pt.	13 12½	61 16
S. E. Pt. ditto	13 04	61 15
King's-Town, ditto	13 02	61 17½
Dominica, N. Pt.	15 39	61 26
South Pt. ditto	15 14	61 21
Point Mulatre	15 16	61 16
Roncau Town	15 18	61 20
Marigallante, N. End	16 4	61 3½
S. End ditto	15 50	61 7
Sable Point, ditto	15 59	61 9½
Guadaloupe, N. Pt.	16 40	61 44
S. W. Pt. or Baffa-terre	15 59	61 43½
Point Malendure, ditto	16 10½	61 52½

Point Sauvcur	16 5N	61 47W
Englishman's Head, ditto	16 31	61 50
Defeada, N. Pt.	16 24	60 56½
S. Pt. ditto	16 16	61 3
Petite Terre, I. ditto	16 14	60 59
Isles des Saints, N. Pt.	15 59	61 25
S. Pt. ditto	15 54	61 29
Antigua, N. E. End	17 3	61 45
W. Pt.	17 3	61 57
N. Pt.	17 7	61 55
Grande Terre, N. Pt.	16 40	61 25
Pt. des Chateaux, dit.	16 14	61 4
Montserat, N. Pt.	16 47	62 12
Redondo Isle	16 54	62 16
Berbuda, N. Pt.	17 50	61 45
St. Eustatia Isle	17 29	62 57
Saba Isle	17 39	63 8½
St. Christopher's N. Pt.	17 35	62 42
S. Pt. ditto	17 24	62 31
Nevis	17 22	62 30
St. Bartholomew, E. Pt.	17 54	62 44
W. Pt. ditto	17 54	62 53
St. Martin's, N. Pt.	18 9½	62 57
S. Pt. ditto	18 0	63 3
E. Pt. ditto	18 4	62 56
W. Pt. ditto	18 51	63 13
Anguilla, N. E. Pt.	18 21	62 54
S. W. End ditto	18 13	63 15
Hat Isle	18 38	63 26
Avis, small Isle	15 50	63 35
Anegada, S. E. Pt.	18 36	64 0
W. Pt. ditto	18 42	64 23
Virgin's Gorda Fort	18 18	64 13
N. Pt. ditto	18 26	64 10
S. E. Pt. ditto	18 15	63 59
St. Croix, E. Pt.	17 51	64 30
W. Pt. ditto	17 53	64 51
Tortola Isle, W. Pt.	18 17	64 39
E. Pt. ditto	18 18	64 24
St. John's, S. Pt.	18 4	64 46
St. Thomas's, the Town	18 22	64 46
N. E. Pt. ditto	18 26	64 41
Crab Isle, E. Pt.	18 5	65 18
Porto Rico, S. E. Pt.	18 9	65 44
N. E. Pt. ditto	18 39	65 38
Fort St. Antonio	18 38	66 25
Cape Rincon	18 40	67 48
Cape Roxo	18 11	67 48
Mona Isle	18 10	68 23
Testigos Island	11 6	61 43
Margarita, N. Pt.	11 7	62 40
N. W. Pt. ditto	11 3	63 20
S. W. Pt. ditto	10 47	63 20
Blanca Isle, N. Pt.	11 44	63 36
Salada Isle, N. E. Pt.	10 59	64 7
Orchilla Isle, N. E. Pt.	11 51	65 2
Rock Isles, Middle	11 50	65 50
Bonair, S. E. Pt.	11 59	67 32
N. W. Pt. ditto	12 22	67 50
Ya Grande, middle	11 55	66 55
Curacao, N. Pt.	12 33	68 45
S. E. Pt. ditto	11 53	68 16

The Variation set down in these Tables is for 1784.

	Lat.	Long.		Lat.	Long.
Hispaniola			Rum Key	23 52	74 12 W
Cape Enganno	18 27	68 46 W	Watland Island, S. Pt.	24 0	73 55
Old Cape Francois	19 40	69 56	Cat Isles, N. Pt.	24 36	75 10
New Cape Francois	19 46	72 13	S. Pt. ditto	24 3	74 43
Cape Nicolas	19 45	73 24	Eleuthera, S. Pt.	24 45	76 12
Cape Donna Maria	18 37	74 22	N. Pt. ditto	25 44	76 40
Cape Tiburon	18 15	74 21	Green Key, S. Pt.	25 17	77 4
Port au Prince	18 42	72 12	N. Providence, E. Pt.	24 58	77 17
Petit Grove	18 27	72 50	Andros Isc, N. Pt.	25 17	78 24
Saona Island, E. End			S. Pt. ditto	24 0	78 0
off ditto	17 53	68 56	Berry's Islands, N. Pt.	25 52	78 25
Baco Pt.	17 53	73 31	S. Pt. ditto	25 21	78 3
Altavala Island off			Anguilla Bank, S. Pt.	23 22	78 42
ditto	17 23	71 55	Double Head Shot Keys		
Jamaica, E. Pt.	17 58	75 38	N. W. Pt.	24 8	80 3
W. Pt. ditto	18 17	78 31	Orang's Key, S. Pt.	24 28	79 32
Kingston	18 4	76 40	Cat Key, N. Pt.	25 14	79 35
Morant Keys off ditto	17 35	75 35	Great Isaac, N. Pt.	26 3	79 38
Pedra Shoals E. Pt.	17 20	77 4	Little ditto	26 8	79 8
W. Pt. ditto	17 30	79 12	Hole in the Wall, S. E. Pt.	26 5	77 40
The New Bear Rocks, fix			Abbaco Key	27 0	77 48
fathom	16 20	78 50	Maranella, Reef, N. Pt.	27 45	79 43
The Bugles	15 40	78 15	Memory Rocks	27 20	79 35
Serranella, middle	16 10	80 40			
Rocks above Water	15 20	79 20			
Pearl Island	14 53	79 8			
Swan's Island	17 20	84 0			
A Dry Bank	18 38	83 15			
Parcel's Shoals S. E. Pt.	15 0	80 15			
Great Cayman, middle	19 20	81 05			
Little Cayman	19 40	80 8			
Old Providence, middle	13 35	80 45			
Andre's Islands, middle	12 30	80 55			
Cuba, E. End Cape Maze	20 18	74 5			
S. W. End, ditto	21 49	85 15			
Cape Cruwz	19 42	77 52			
Isle of Pines	21 30	83 20			
S. W. End ditto	23 12	82 12			
Havannah	20 27	68 54			
East Reef, off Hispaniola	20 33	69 7			
North Reef ditto, E. Pt.	20 51	69 48			
Triangle	21 24	70 14			
Square Handkerchief, N. Pt.	21 5	70 44			
S. Pt. ditto	21 30	70 58			
Salt Key	22 15	71 45			
Caycos, Isles, N. Pt.	21 12	71 37			
S. Pt. ditto	21 35	72 56			
Heneaga, N. E. Pt.	21 12	73 32			
S. W. Pt. ditto	21 55	72 51			
Little Heneaga, N. Pt.	22 51	72 52			
Mayaguanna, N. Pt.	22 52	73 27			
French Keys	22 26	73 55			
Acklin's Keys, S. Point	21 45	73 46			
Hogtie's Middle	22 21	74 1			
South Key	23 10	73 50			
Croked Island	23 27	73 26			
Atwood's Keys, E. Pt.	23 37	74 46			
Long Island, N. Pt.	22 48	74 22			
S. Pt. ditto	22 12	75 10			
Key Verde	22 44	75 0			
The Brothers, middle					

	H. W.	Lat.	Long.		H. W.	Lat.	Long.
Cape Wallingham	12	0 62 40	78 0	Cape Spear		47 33	52 15
Cape Diggs	12	0 62 45	78 48	Cape St. Frances		47 54	52 25
Mansfield, N. End	12	0 62 40	78 0	Bellisle, Conception			
Ditto S. End	12	0 61 35	81 30	Bay		47 43	52 47
Sleeper's Island		60 10	81 30	Baccalao Island		48 24	52 29
Great ditto		58 35		Point Graces		48 24	52 34
Cape Pembroke	12	0 62 57	82 10	Trinity Harbour		48 38	53 0
Large Swan's Nest	12	0 62 20	83 30	Cape Bonavista		47 43	52 33
Cape Southampton	12	0 62 10	86 10	Inner Goolberry Is-			
Churchill River	7	0 58 47	94 7	land		49 15	53 6
Charlton Isle		52 3	79 5	Stinking Islands		49 28	52 45
Port Nelson Shoals	7	0 57 35	92 30	Cape Freels		49 55	52 55
Hay River	7	0 57 10	93 0	Funk Island		50 0	52 10
<i>Newfoundland.</i>				Dureto Lodge		50 10	52 40
Belle Isle, N. Pt.		51 57	55 35W	Wadham Islands		49 57	53 32
S. Pt. ditto		51 48	55 35	Cromwell's Lodge		50 12	53 25
Quirpon Harbour &		51 40	55 32	Cape Fogo, on Islan.			
Cape Norman	9	0 51 39	55 58	Fogo		49 57	53 42
Anchor Pt. Var. 24	9	0		Rocks off ditto		50 10	53 45
30 W		51 15	56 47	Twelinge Islands		50 2	54 36
Point Ferroll		51 4	57 6	Cape St. John		50 10	55 32
St. John's Island	1	0 50 50	57 20	Horfe Islands		50 23	55 46
Point Rich		50 40	57 25	Cape Partridge,			
Point Sable		50 24	57 30	White's Bay		50 17	56 10
Cow Head		49 53	57 50	Orange Bay		50 34	56 22
St. Paul's Bay		49 50	57 50	Green Island		50 46	55 40
Cape St. Gregory,				Ditto, N. Pt.		51 0	55 37
Var. 22° 40' W.		49 23	58 13	Hooping Harbour		51 56	56 10
Bay of Islands N.				Crouch Harbour		50 56	55 54
Head		49 16	58 13	Croque Harbour		51 5	55 52
S. Head		49 6	58 24	St. Anthony's Cape,			
Red Island		48 34	59 11	Hare Bay		51 17	55 38
Cape St. George,				<i>Coast of Labradore.</i>			
Var. 19° W.		48 28	59 7	York Point		51 57	55 50
Cape Anguille		47 54	59 17	Fortune Bay		51 28	56 55
Cape Ray, Var. 20				Grands Point		51 24	57 11
W.		47 37	59 10	Old Fort Islands, Ef-			
Burgeo		47 33	57 36	quimaux Bay		51 24	57 43
Pinguin's Island		47 22	56 57	Great Mecatina, Pt.		50 42	59 8
Brunett Island, For-				Little ditto Island		50 36	59 26
tune Bay		47 10	55 55	Mary's Island		50 16	59 45
Boxey Pt. ditto		47 36	55 35	Waskemashin Island		50 3	59 50
Fortune Head, 18°				Mount Isle		50 5	61 30
30 W. Var.		47 6	55 45	Esquimaux Islands		50 10	63 0
Cape Miquillon		47 3	56 13	Anticosti Islands, S.			
S. Pt. ditto		46 34	56 3	E Pt.		49 7	61 27
Point May		46 54	55 57	N. W. Pt.		49 48	64 8
Point Gaules		46 47	55 40	Grande Bay		50 18	64 0
Chapeau Rouge, or				Seven Island Bay,			
Red Hat		46 51	55 21	Entrance		50 5	65 40
Mortir's Rocks, off				Bald Mountain		49 52	66 28
ditto		47 0	54 50	English Harbour		49 29	66 55
Placentia Bay		47 0	55 8	Hare Island, N. Pt.		48 3	68 33
Cape St. Mary's		46 52	54 3	Mount Camile		48 41	67 13
St. Mary's Keys		46 45	54 3	Cape Cat		49 4	66 13
Cape English		46 49	58 24	Magdalen River		49 13	65 17
Cape Pine		46 42	53 15	Cape Rosiers		48 56	63 35
Cape Race		46 43	52 44	Gaspay Bay		48 46	63 31
Cape Ballard		46 49	52 35	Bonaventura Island		48 33	63 27
Black Head		47 3	52 33	Cape Ann		48 29	63 38
Cape Broyle		47 7	52 31				
Bay of Bulls		47 20	52 24				

	H. W.	Lat. N	Long. W		H. W.	Lat.	Long. W
Misco Island, Entrance, Chaleur Bay		48 8	64 16	Monttick Point, Long Island		40 50 N	71 57
Magdalen Island, N. W. Point		47 35	60 54	Sandy Hook		40 25	74 0
S. W. Point		47 15	61 54	New York	3 0	40 43	74 5
Crofs Island, W. Point		47 46	61 0	Cape May	8 1/4	38 58	74 51
Bird's Rocks		47 43	60 30	Philadelphia		39 57	75 7
Island St. John's, N. Cape		47 8	64 5	Cape Henlopen		38 46	75 4
E. Pt. ditto		46 28	62 0	Falfe Cape		38 38	75 2
Cape St. Lewis		46 0	61 48	Cape Charles		37 9	75 50
St. Paul's Island		47 13	59 57	Cape Henry 5° 15' W	11 0	36 57	75 51
Cape Breton, N. C.		47 7	60 8	Cape Hatteras Var. 4° 20' W.	11 0	35 6	75 46
Mira Bay		46 5	59 44	Shoalsoff ditto, S. Pt.		34 45	76 28
Scatari Island		46 3	59 30	Cape Lookout	10 0	34 22	76 44
Sunk Rock, off Cape Breton		45 51	59 24	Shoals off ditto, S. Pt.		34 10	76 40
Cape Breton		45 54	59 39	Cape Fear		33 51	78 20
Louisbourg		45 54	59 49	Frying Pan Shoals, S. E. Pt.		33 39	78 17
Cape Canfo, Var. 15° 15'	8 30	45 16	60 50	Great Town Entrance		33 18	79 30
Island Sable, E. Pt. Var. 15°	8 30	44 8	59 55	Cape Roman		33 5	79 52
W. Pt. ditto		44 4	60 30	Charles Town Light House	7 0	33 42	80 40
Sandwich Bay, Var. 14 10	9 0	45 8	61 35	Port Royal	7 0	32 6	81 14
Cape Southampton, 13 53	10 0	44 46	62 13	Savannah Sound		31 57	81 19
Hallifax Harbour, W. 14 0 Var.	8 0	44 36	63 23	St. Catherine's Island		31 36	81 36
Cape Sambro, Light House, 13° 35' V.	8 0	44 30	63 27	St. Augustine, 6° E. Var.		29 50	82 21
Charlotte Bay 13 30 Var.	8 0	44 34	63 50	Cape Canaveral Sho. 2° E. Var.		28 20	80 46
Port Campbell, or Rosway 12 42	8 1/4	43 40	65 12	Cape Florida, 6° 30' E.		25 44	80 32
Cape Sable 11 15	8 0	43 26	65 31	Dry Tortugas Shoals Var. 7° 40' E.		24 15	83 27
Seal Island 11 0	8 3/4	43 25	65 55	Cape Sable, in Florida, Var. 6° 0' E		24 57	81 44
Cape Taboque 11 45	9 0	43 48	66 1	Chatham Bay		25 43	82 15
Cape Mary	9 0	44 10	66 7	Cape Roman		25 40	82 20
Breyer Island, Var. 11 15 W.	9 1/2	44 19	66 20	Charlotte Harbour, Florida, Var. 13° 30'	8 0	26 40	82 32
Trinity Ledge	9 0	44 5	66 14	Spiritu Sancto, Var. 5° 50' E.		28 0	83 30
Anapolis Royal 11 15	10 0	44 47	65 43	Cape St. Blaz		29 44	85 30
Cape Chegnacto 13 40	11 0	45 25	64 46	Mississipi River Mou.		28 55	89 15
River St. John's		45 20	66 0	River Bravo Mouth		26 0	97 40
Fundy's Bay		44 3	67 50	Vera Cruz		19 10	95 5
Mount Defart Rock		43 1	68 45	St. Ann's		18 10	92 20
Cathe s Ledge		42 51	70 4	Campeachy		19 10	90 20
Cape Ann Light-house	10 0	42 25	70 31	St. Piedras		21 4	90 30
Boston	10 0	42 5	69 40	Cape Catoche		21 26	88 13
Cape Cod	9 0	40 10	68 55	Falfe Cape		20 55	85 50
Nantucket Shoals		41 14	69 23	Ratan Island, Bay of Honduras, E. Pt.		16 25	87 0
Ditto Islands		41 18	70 26	Bonacoa Island, ditto E. Pt.		16 36	86 20
Noman's Land		41 23	70 30	Punta de San Blas		9 30	78 38
Grey Head		41 25	71 15	Porto Belio		9 32	79 44
Rhode Island Harb.		41 17	72 28	Gulph of Darien		8 30	76 40
Judith Point		40 57	71 37	Carthagena		10 27	75 20
Block Island Middle							

	Lat.	Long.		Lat.	Long.
St. Martha	11 25 N	74 4 W	Payta	5 0	79 40 W
Roco Grande	11 5	7 34	Cape Blanco Peru	3 48	88 40
Cape de la Vela	12 10	71 58	Quito	13 0 S.	77 50
Cape Coque Bacoa	12 10	70 40	Guiaquil	2 11 S.	81 5
Aruba	12 10	69 40	Panama	8 48 N	79 45
Curacoa, W. Pt.	12 31	68 44	Acapulco	17 10 N	104 30
Bonair, N. Pt.	12 21	67 50	Point Mala, Coast of Para-		
Cape de St. Roman	11 48	69 40	gua	7 35 N	80 45
Cape Codras	10 52	65 32	Cape Blanco Nicaragua	9 18	85 45
Cape Three Points	10 38	61 52	Cape Corientes	19 45	110 0
River Oronooko Mouth	8 30	59 0	Port Guatamala	14 0	92 35
Essequibo	6 55	57 45	Cape St. Catherine	10 40	86 45
Surinam	6 10	54 45	Amapalla	12 40	89 5
Cayenne	5 25	52 0	Cape Remedie, Coast of		
Cape North	1 58	49 49	Guatamala	12 50	93 0
			St. Thomas's Island	20 10	113 0

South America.

Island St. Juan	1 20 S.	45 0
Mouth of River Omara	5 0	35 55
Fernando Loronho	3 48	30 50
Cape Roque	5 0	35 45
Cape St. Augustine	8 50	35 10
River St. Francisco	10 55	36 40
Bay of Todor Sanctos	13 5	39 0
Port Segura	17 0	40 0
Spiritu Sancto	20 20	40 0
Cape Frio	22 54	42 38
Rio Janeiro	22 54	42 38
St. Catherine's	27 35	49 11
Cape Maria	35 0	55 8
Buenos Ayres, River Plate	34 35	51 55
Cape St. Anthonio	36 30	45 40
Cape Mattas	45 5	64 20
Cape Elanco Patagonia	47 20	64 36
Port Desire, to make it with Steeple Rock on the Side of it	47 0	64 0
Port St. Julian	49 10	68 40
Cape St. Juan	54 47	63 41
Falkland Islands	51 30	61 27
Cape Success	51 1	35 30
Cape Virgin	52 23	67 40
Cape Diago	54 33	64 10
Straits Magellan Entrance	52 21	67 40
Cape Deseada	55 4	74 12
Staten Island	55 0	72 35
Evot's Island	55 34	66 36
Cape Horn	55 58	67 20
Christmas Sound	55 22	69 57
Barnvelt's Island, Terre de Fuego	55 49	66 58
York Minster	55 26	70 2
Cape de los Pilares, En- trance of Magellan Straits	53 15	78 20
Conception Bay	36 43	72 34
Cape Roman	48 20	76 35
Juan Ferdinando's Island	32 3	73 43
Valparaíso	33 3	72 13
Coquimbo	29 54	71 10
Yilo	17 36	71 7
Arica	18 27	71 5
Lima	12 1	76 40

Coast of California.

Cape Conception	36 0	126 0
Cape Mendocin, discovered by Sir Francis Drake in the Year 1578, New Al- bion	42 20	130 0
Mouth of the River of the West, discovered 1603, by M. d' Aquilar, said to join Nelson's River	44 30	131 0
Coast discovered by Captain Ischirckow in 1741, and B C Bering in 1741	55 60	137 0
St. Joseph's	23 4	109 36
Cape Silius	59 10	146 30
Cape St. Hermogenies	58 45	154 20
Island St. Stephen, at the Mouth of the Sea Kamf- chatka	50 45	180 25

Southern Islands in the Atlantic

St. Matthew's	1 23 S.	6 10 W
Ascension	7 57	14 18
St. Helena	16 4	5 54
Fernandepo	3 2 N	3 32
Princes	1 30	9 32
St. Thomas	0 0	7 0
Cape Podron	6 0 S.	11 40
Annabona	1 26 N	8 10
St. Phillip's	12 22 S.	13 20
Tristian de Cunha	37 10	13 20
Isle de Picos	24 0	16 20
I. Martinwas	21 0	18 40
I. St. Maria	20 0	18 40
Isle Trinidad	20 30	25 30
Isle Ascension	20 40	28 30
I. Fernando Noronha	3 56	32 35
I. Rocas	5 0	35 40
I. Sabaldes	50 53	50 35
Whitsunday Island	19 26	137 56
Queen Charlotte's Island	19 18	138 4
Egmont Island	19 20	138 30
Duke of Gloucester's Island	19 11	140 6
Duke of Cumberland's Isl.	19 18	140 34
Prince William Henry's Isl.	19 0	141 6

	Lat.	Long.		Lat.	Long.
King George III's } S.E. end	17 48	149 15	Hamchatka Upper	54 48	157 25 E
I. or Otaheite } NW end	17 30	152 0	I. Kagrahenskoy	58 0	162 10
Duke of York's Island	17 28	150 16	Cape St. Thaudus	62 10	175 5
Sir Charles Saunders's Island	17 28	150 4	<i>The Coast of Barbary and Guinea.</i>		
Lord Howe's Island	16 46	151 13	Cape Spartel	35 42 N	5 50 W
Scilly Island	16 28	174 30	Larache	35 11	6 5
Boscawen's Island	15 50	175 10	Sallee	34 5	6 38
Augustus Keppel's Island	15 53	175 13	Cape Blanc	33 4	8 20
Wallis's Island	13 18	177 0 W	Cape Cantin	32 37	8 50
Adventure Bay, N. Holland	43 23	147 0 W	Mogadore	31 27	9 25
Adventure I. S. Sea	17 9	144 18 N	Saphie	32 20	8 40
Ambrym I. ditto	16 9	168 12 E	Cape de Gee	30 30	10 8
Amsterdam I. ditto	21 9	174 46 W	Cape Croix	30 38	9 50
Annamocka ditto	20 16	174 30 W	Cape Nun	28 47	10 55
Apac I. ditto	16 46	168 27 E	Cape Bojadore	26 30	14 21
Aurora I. ditto	15 8	168 17 E	Cape das Barbas	22 15	16 54
Bolscherefskoi, Siberia	52 54 N	156 37 E	Cape Blanco	20 55	17 5
Bristol Cape, Sandwich-			Senegal	15 53	16 36
Land	59 2	26 51 W	Cape de Verd*	14 46	17 27
Buller Cape, South Georgia	53 58	37 40	Shoals off Ditto, S. Point	14 46	19 26
Candlemas I. Sandwich Land	57 10	27 13 W	N. Point	17 30	
Charlotte Cape, S. Georgia	54 32	36 11 W	River Gambia Entrance	13 28	16 15
Cape Coronation, N. Caledonia	22 55.	167 8 E	Cape Rouge	12 15	16 20
Commin I. S. Sea	31 40 N	8 4 E	R. de Sierra Leona Entr.	8 22	12 8
Gunief, Siberia	47 7	51 57 E	Cape Mount	6 38	9 44
Hinchinbroke I. S. Sea	17 25 S.	168 30 E	Cape Mezurado	6 12	9 3
Hood's I. ditto	9 26	138 52 W	River Sestos Entrance	5 30	7 42
Jakutskoi, Siberia	62 1 N	129 47 E	Cape Palmas	4 18	5 25
I. of Pines, S. Sea	22 38 S.	167 38 E	R. St. Andrew Entrance	5 8	4 20
Port Madre de Dios Afia, ditto	9 55	139 8 W	Cape la Ho	5 2	3 16
Madalena, I.	10 25	138 49 W	Cape three Points	4 32	0 5 E
Makelyne, I. ditto	16 32	167 59 E	River Volta	5 48	1 42
Montago, I. ditto	17 26	168 31 E	Road of Juda in the Gulph		
Norfolk, I. ditto	29 2 N	168 10 E	I. of Benin	6 10	5 58
Obevahea I.	9 40 S.	139 1 W	R. Formosa, or Benin En.	6 38	4 52
Ohitahoo I.	9 55	139 6 W	Benin Town	7 42	7 28
Onatiayo I.	9 58	138 51 W	Cape Formosa	4 32	8 15
Osnaburgh I.	17 52	148 6 W	New Calabar River Entr.	4 30	9 15
Huahimi I.	16 44	151 8 W	Old Calabar River Entr.	4 32	10 33
Palliser's I. ditto	15 38	146 30 W	R. Cameron Entrance	4 0	11 24
Palmerston's I. ditto	18 0	162 57 W	Isle Fernando Po	3 8	10 33
Paoom I. ditto	16 30	168 28 E	Prince's Isle	1 30	9 32
Portland I. ditto	39 25	178 12 E	St. Thomas's Isle, N. P.	0 42	8 30
Pylestaart's I. ditto	22 23	175 41 W	Cape St. John	1 11	10 38
New Hebrides, ditto	14 56	167 20 E	River Gabon Entrance on the Equator	0 0	10 50
Sandwich I. ditto	17 40	168 33 E	Cape Lopas Gonfalso	0 50 S	10 23
Shepherd's I. ditto	16 58	168 42 E	Isle Annabona	1 26	8 10
Toankaa I. ditto	14 30	145 9 W	Cape St. Catherine	2 9	10 43
Tobolski, Siberia	58 12	168 13 E	Majumba, or Alva Entrance of Bay	3 15	11 17
Tonga Tabu I. S. Sea	21 9	174 49 W	Cape Padron	5 55	12 58
<i>Coast of Siberia.</i>			The Town of Congo	6 6	13 30
Cape Chiokotskago	64 0	174 45 W	Cape Ledo	9 30	13 10
Cape Chuckehenio	66 30	171 10	Benguela	12 8	12 39
Holy Cape	72 32	179 45 E	Cape Negro	16 2	11 15
Hamchatka Lower	56 11	159 25	Bay of Conception, or Gulph of St. Thomas Entrance	24 42	13 13
			Cape Voltas	28 55	15 53
			Bay of St. Helena, or St. Martin	31 42	17 33

*The Co
nen*

Cape of G
Cape Han
Fals Bay
Cape Fall
Cape Laq
Cape Baff
Logoa Bay
River St.
Point Nat
St. John's
Bay of N
River St.
C. Fumos
Algoa Ba
River Ma
C. Corien
C. St. Se
W.
I. Bazar
Sofala
River Cu
Angosha
Mofamb
St. Laza
C. Delg
Quilao
Montia
Zenziba
Pemba
Momba
Melinda
B. Forn
R. Rou
R. Ma
C. Das
C. Orf
C. Gu
Aden
Straits
tran
Moche
C. Az
I. Sab
C. R
Island
Suake
Judda
Macc
C. N
C. C
Mou
Suez
C. F
E. E
Cape
Cape
Cap
Mal
Cap
to
P

The Coast of the Main Continent in the East Indies.

	Lat.	Long.		Lat.	Long.
Cape of Good Hope	34 29 S.	18 29 E.	G. Ormus	27 5 N	56 30 E.
Cape Hanglip	34 16	18 50	Gombaroon	27 15	56 12
Fals Bay	34 10	18 50	I. Kishme	26 29	55 45
Cape Falso	34 16	18 39	Congo	26 45	55 25
Cape Laquillas	34 41	20 32	Island Cayen	26 30	54 0
Cape Bassas, or Baxas	34 26	22 30	Is. Samake	26 16	49 10
Logoa Bay	33 25	25 45	Is. Baharen	26 40	43 50
River St. Christopher's	32 47	27 38	Kadherma	28 16	48 0
Point Natal	31 50	27 38	Baffora, or Bafra	30 30	48 3
St. John's River	31 45	33 15	Cape Bardistan	28 0	52 5
Bay of Natal	29 25	33 10	Mouth R. Euphrates	30 49	48 30
River St. Lucia	28 20	30 50	Agra	26 43	76 49
C. Fumos	27 27	31 5	Cape Nabon	27 36	51 58
Algoa Bay, St. Mary's	25 48	31 10	Cape Jacques	25 36	57 20
River Manica	23 31	32 2	Cape Goadel	24 25	64 5
C. Corientes	24 0	34 50	Cape Mohanzo	24 25	67 15
C. St. Sebastian, Var. 25°			Kafha	23 55	71 2
W.	22 41	34 30	M. Indus R. Tatta	24 50	58 26
I. Bazarutto	21 55	34 35	Giant's Point	22 10	63 24
Sofala	20 29	33 30	Dui Point	20 40	69 45
River Cuama	18 14	36 10	G. Gambaya	22 20	71 27
Angosha, or Angoxa	16 30	38 40	Surat	21 10	72 25
Mofambique	15 18	40 53	Daman	20 20	72 6
St. Lazarus Bank	12 8	41 20	Cape St. John	20 0	71 30
C. Delgada	10 10	41 12	Bacain	19 32	72 0
Quiloa	8 40	39 58	Bombay	18 5	72 45
Monfia Islands	7 36	40 45	Rajapore	17 4	72 45
Zenzibas Islands	6 55	40 10	Caimfer's Bank	16 25	71 45
Pemba Islands	4 32	40 45	Coral Bank	16 0	71 45
Mombas	3 50	41 28	Elizabeth Bank	16 59	71 5
Melinda	2 53	42 15	Turnt Islands	5 30	73 35
B. Formosa	2 30	42 30	Goa	5 31	73 50
R. Rouges	2 2	44 30	Cape Rama	15 10	73 40
R. Magadoxa	1 57 N	47 27	Carave	14 55	73 54
C. Das Bassas	4 50	49 43	Tellicherry	11 50	75 8
C. Orfui	10 25	52 10	Mount Dilly	12 5	75 0
C. Guardafoy	11 45	52 17	Calicut	11 21	75 33
Aden	13 2	46 28	Cochin	10 0	75 52
Straits of Babelmandel Entrance of the Red Sea	12 45	43 50	Cape Comorin	7 55	78 10
Mocho	13 19	44 15	Manapar	8 30	78 12
C. Azab	12 42	42 28	Cape Calminera	10 15	79 45
I. Sabagar	15 0	42 33	Negapatnam	10 35	80 3
C. Rat	11 45	41 2	Pagodas	11 16	80 5
Islands Dahlac	15 30	39 50	Frankbor	10 54	80 3
Suaken	19 33	36 10	Fort St. David's	11 57	80 5
Judda	21 29	39 26	Pondicherry	11 46	79 57
Macca	20 35	40 0	Madras, St. George	13 5	80 34
C. Nofe	23 50	35 10	Paliakate	13 30	79 55
C. Caofir	25 20	34 5	Dui Head	16 10	81 45
Mount Sinai	29 30	33 20	Masulipatanam	17 36	83 28
Suez	30 2	32 21	Chicakol	18 30	84 7
C. Fartash, or Fortauch N.			Ganjam	19 18	85 32
E. Entrance of the Red Sea	15 30	52 30	Balafore	21 20	86 0
Cape Morbat	16 45	55 30	P. Palmiras Mouth of the		
Cape Rafalgate	22 16	60 5	Ganges.	20 50	87 30
Cape Marha	18 30	58 0	Cape Kidgerree	21 48	88 55
Malkate	23 30	38 13	Chandernagore	22 53	88 34
Cape Mozandum, or Mufeldom, Perian Gulph Entrance	26 17	56 25	Islamabad	22 20	91 50
			Hugley	23 56	88 34
			Calcutta	22 34	88 35
			St. Martin's Is.	20 0	91 45
			Aracan R.	19 57	92 25
			Chedula Is.	18 35	92 30
			P. Negrais	16 9	92 30
			Tavay River	13 30	96 45

	Lat.	Long.		Lat.	Long.
Martaban Gulf	16 15 N.	96 10 E.	Foul Pt.	17 40 S.	49 58 E.
Marghi	11 59	97 15	Cape St. Andrews, V.		
Junkselon	8 0	97 0	21 50 W.	16 35	44 20
Pulo Pinang	5 30	98 45	Cape St. Sebastian	12 30	46 29
Straits of Malacca	2 12	95 5	Cape de Ambra, or		
Malacca	2 15	102 5	Natal	12 15	49 15
Point Romania	1 17	104 26	B. de Antongill	16 0	49 08
G. of Siem	9 30	102 0	Antavares	21 5	47 04
Cape Patina	7 1	100 30	Matatanes	22 15	46 45
Cham	12 45	100 30	Cape Ramos	25 0	46 9
Siam, or Judia,	14 18	100 53	Bassos d'India	22 30	40 46
C. Liam	12 30	100 1	Querimbo	12 22	40 50
Manfapa	12 20	101 30	A Rock	21 35	39 15
Ponthimas	10 4	105 30	A Rock in	21 28	41 30
Cambodia Point	8 55	105 39	St. Christopher's	17 19	42 18
R. Cambodia's Mouth	19 30	107 15	English Bank	17 56	39 3
	10 0	107 40	Isle of Fire	17 20	32 15
Cape St. James	10 32	108 7	St. Juan de Nova	17 5	41 20
Comorin Bay	11 50	110 10	Mayotta	13 0	45 30
Waffen's Bay	12 15	110 15	Mohilla	12 20	43 50
Cape Avralla	13 1	110 10	Bassas de Chagas	6 40	72 50
Banbom	14 55	108 30	Joanna	12 18	44 50
Cape Touron	16 40	108 45	Cocos Island	12 30	96 0
Paffien Bay	26 35	107 47	Comora	11 30	48 53
R. Tonquin	20 47	107 0	Gloriosa	12 44	47 30
Suiven Point	20 10	110 45	Apalioria	19 59	85 0
Canton	23 7	113 8	Bank of Patrom	5 3	62 45
Ningpo	25 58	120 23	De Gama	2 20	74 15
Hoai Neghan	33 35	118 56	Juan de Nova	9 58	51 0
Nankin	33 30	120 0	Padro de Banhas	5 39	50 45
Singhangfu	34 16	108 50	St. Francisco	6 21	53 0
Pekin	39 55	116 36	Isle Amarantes	5 27	48 45
Straits of Bali, S. Entra.	8 39	114 30	Seven Brothers	3 25	60 30
N. Entra.	7 54		Sea Cows	3 36	50 46
Straits of Banca, W. Ent.	2 0	102 45	Three Brothers	3 45	62 30
E. Entra.	3 0	103 43	Mascarenhas	2 55	56 55
Straits of Sunda, S. Entra.	5 58	103 5	I. Seychelles H. W.	4 37	55 38
Straits of Malacca, N. W.			Carpo Santo	6 30	56 44
Entrance	6 15	94 45	Diego Rais	0 45	70 25
Straits of Singapore, or S.			Padro Banhos	6 50	70 25
E. Entrance of the Ma-			Little Comoro	10 10	44 15
lacca Straits	1 10	104 17	Diego Garcia	7 42	75 3
Straits of Sapi	8 34 S.	119 45	Caudu	5 55	73 30
Straits of Manilla	13 45 N.	120 30	St. Brandon	16 38	62 55
Parcellar Hill, Strait of Ma-			Rodrique	19 41	63 17
lacca, Var. 1 30 W.	3 15	101 2	Bourbon, St. Dennis	20 52	55 35
			Mauritus	20 10	57 32
The Tide flows N. N. E. and S. S. W.			Cocos Island	12 20	56 5
and the Flood runs E. S. E. and ebbs			Christmas Isle	10 45	104 30
W. N. W.			Nassaw	3 0	100 25
			Isle Good Fortune	1 30	90 30
			Minta	0 26	98 5
			Engona	5 15	102 45
			N. Part	6 0	94 35
			Acham, or Acheen	5 20	95 35
			Point Bassie	5 27	94 45
			Diamond Point	5 17	97 5
			Bencoolen	3 49	102 4
			South Point	6 2	104 16
			R. Palambam	3 2	104 45
			Banca, S. End	3 15	107 10
			N. West End	1 50	105 30
			Prince's Isles Straits of		
			Sundy	5 30	103 30
			Middle Isle ditto	5 57	104 40

Islands in the East Indies.

Dutch Bank	38 0 S.	33 40 E.
Amsterdam	38 30	74 0
St. Paul	37 52	77 55
New Holland, S. Point	37 15	147 30
Leuwin's Land ditto	35 0	130 0
Cape York ditto	11 15	141 0
Sandy Cape West Point	25 30	171 0
George's Cape	35 15	151 0
Tryal's Rocks off ditto	19 0	105 2
Cape St. Mary	25 34	44 12
Star Bank	25 0	43 10
B. C. Augustine V.		
24 W.	23 35	43 21
Cape St. Vincent V.		
22 26 W.	21 30	43 03

	Lat.	Long.		Lat.	Long.
Java Head	6 49N	106 55E.	Pulo Timon	2 45N.	104 30E
Bantam Ditto	6 0	105 49	Pulo Aroe	3 0	105 0
Batavia	6 12	106 43	Anamba	2 58	106 45
Cape Sandana	7 42	114 30	Natuna	4 0	108 38
E. Point	8 42	114 37	Goat Is.	13 55	120 7
Lombok	8 30	116 30	Pulo Condor	8 40	107 25
Cumbava	9 28	118 20	Banguay	7 12	117 35
Rotto	11 25	123 45	Pulo Sapata	9 54	109 57
Timor, N. E.	9 0	128 0	Paragua, S. Point	8 12	117 50
West Point	10 30	122 55	I. Negros, S. Point	9 15	120 20
Timorland, N. Point	9 0	123 12	N. Point	11 20	120 20
New Guinea			N. Point	9 40	126 45
Cape Deliverance ditto	11 30	157 55	Panguel Bay	7 55	124 30
Cape of Good Hope ditto			S. E. Point	6 40	127 30
West Point ditto	1 32	131 40	Mindanas		123 0
New Britain, N. Point	1 30	148 10	S. W. Point	6 45	122 2
South Point	6 55	149 0	Cape Augustine	6 30	126 0
Ceram East Point	3 56	131 15	S. Point	5 45	122 45
W. Point	3 36	127 46	Mindora S. Point	12 0	121 30
Boero, or Burro	3 30	126 20	N. W. Point	13 30	119 15
Providence Is.	0 20	135 0	Panay, S. Point	10 33	122 4
Gilola, S. Point	0 20	145 0	N. Point	11 42	120 0
N. Point	1 15N.	145 0	N. Point	13 45	120 20
N. E. Point	1 15	124 37	Manilla	14 30	120 20
N. W. Point	1 40	120 50	N. Point	19 0	121 25
W. Point	4 55S.	117 55	C. Baxeadore ditto	18 44	120 40
S. W. Point	4 40	119 5	Diamond Isle	15 42	193 15
S. Point	5 56	119 55	South Point	21 45	121 36
S. E. Point	5 0	121 40	N. Point	25 15	121 45
Macassar	5 10	119 7	N. E. Point	25 15	122 15
E. Point	1 2N.	118 30	Man-han	23 30	121 15
W. Point	0 0	108 57	Hainan, S. Point	18 22	109 30
N. Point	7 5	117 20	N. E. Point	19 55	111 10
S. Point	4 15S.	114 30	Van Cheau	18 50	110 45
Balambangan	7 19	117 12	Paracles Is. S. Part	11 45	110 45
Socrata, E. Point	11 59N.	55 7	N. Part	16 30	111 45
W. Point	12 25	54 12	Macao	22 14	113 50
I. Halabi	16 50	56 52	Leykeyo, N. Part	28 0	128 10
Abdelour	11 55	53 45	S. Part	25 30	128 30
Lakedivas Is. N. Point	13 33	70 3	Cummin	31 40	121 4
E. Part	10 3	71 30	Homdo, S. Point	32 20	129 54
Maldevas Limits	8 30	74 30	Nanagacqui	32 30	128 50
Point de Gale	1 30	76 30	Dos Cavalhos	32 32	129 53
Infanapatnum	6 15	80 20	N. Part Cape Sugar	40 20	140 25
N. Part	9 47	80 55	Cape Nebo	39 15	142 5
Trincomalay	9 45	80 20	Pescadores Is. S. End	11 0	167 30
E. End	8 32	81 40	N. Part	11 20	167 0
W. End	7 30	82 15	The Triangles, N. Part	17 5	112 4
I. Cocos	6 15	80 20	Woody Island	1 46	106 10
Great Andaman	14 30	92 10	The Elephant and Camel	9 2	113 3
Little Andaman	14 0	92 0	Andradas Rock	9 51	110 50
Cor. Nicobar	11 45	92 0	Victory Island	1 43	106 48
Nicovari	10 30	92 3	Pulo Runda	6 0	95 30
Nicobar	9 12	92 32	Foul Island	18 6	92 23
Puloway	8 3	93 45	Macclesfield Shoal	15 0	114 20
Pulo Passang	7 22	92 45	Pulo Pera	6 10	97 46
	5 55	95 2	Three Brothers	10 32	108 4
	5 52	104 30			

A Table of Meridional Parts.

M.	od.	1d.	2d.	3d.	4d.	5d.	6d.	7d.	8d.	9d.	10d.	11d.	12d.	13d.	14d.
0	0	60	121	181	240	300	361	421	480	542	603	664	725	787	848
1	1	61	122	182	241	301	362	422	483	543	604	665	726	788	849
2	2	62	122	183	242	302	363	423	484	544	605	666	727	789	850
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	851
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	852
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	853
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	854
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	855
8	8	68	128	188	248	308	369	429	490	550	611	672	733	795	856
9	9	69	129	189	249	309	370	430	491	551	612	673	734	796	857
10	10	70	130	190	250	310	371	431	492	552	613	674	735	797	858
11	11	71	131	191	251	311	372	432	493	553	614	675	736	798	859
12	12	72	132	192	252	312	373	433	494	554	615	676	737	799	860
13	13	73	133	193	253	313	374	434	495	555	616	677	738	800	861
14	14	74	134	194	254	314	375	435	496	556	617	678	739	801	862
15	15	75	135	195	255	315	376	436	497	557	618	679	740	802	863
16	16	76	136	196	256	316	377	437	498	558	619	680	741	803	864
17	17	77	137	197	257	317	378	438	499	559	620	681	742	804	865
18	18	78	138	198	258	318	379	439	500	560	621	682	743	805	866
19	19	79	139	199	259	319	380	440	501	561	622	683	744	806	867
20	20	80	140	200	260	320	381	441	502	562	623	684	745	807	868
21	21	81	141	201	261	321	382	442	503	563	624	685	746	808	869
22	22	82	142	202	262	322	383	443	504	564	625	686	747	809	870
23	23	83	143	203	263	323	384	444	505	565	626	687	748	810	871
24	24	84	144	204	264	324	385	445	506	566	627	688	749	811	872
25	25	85	145	205	265	325	386	446	507	567	628	689	750	812	873
26	26	86	146	206	266	326	387	447	508	568	629	690	751	813	874
27	27	87	147	207	267	327	388	448	509	569	630	691	752	814	875
28	28	88	148	208	268	328	389	449	510	570	631	692	753	815	876
29	29	89	149	209	269	329	390	450	511	571	632	693	754	816	877
30	30	90	150	210	270	330	391	451	512	572	633	694	755	817	878
31	31	91	151	211	271	331	392	452	513	573	634	695	756	818	879
32	32	92	152	212	272	332	393	453	514	574	635	696	757	819	880
33	33	93	153	213	273	333	394	454	515	575	636	697	758	820	881
34	34	94	154	214	274	334	395	455	516	576	637	698	759	821	882
35	35	95	155	215	275	335	396	456	517	577	638	699	760	822	883
36	36	96	156	216	276	336	397	457	518	578	639	700	761	823	884
37	37	97	157	217	277	337	398	458	519	579	640	701	762	824	885
38	38	98	158	218	278	338	399	459	520	580	641	702	763	825	886
39	39	99	159	219	279	339	400	460	521	581	642	703	764	826	887
40	40	100	160	220	280	340	401	461	522	582	643	704	765	827	888
41	41	101	161	221	281	341	402	462	523	583	644	705	766	828	889
42	42	102	162	222	282	342	403	463	524	584	645	706	767	829	890
43	43	103	163	223	283	343	404	464	525	585	646	707	768	830	891
44	44	104	164	224	284	344	405	465	526	586	647	708	769	831	892
45	45	105	165	225	285	345	406	466	527	587	648	709	770	832	893
46	46	106	166	226	286	346	407	467	528	588	649	710	771	833	894
47	47	107	167	227	287	347	408	468	529	589	650	711	772	834	895
48	48	108	168	228	288	348	409	469	530	590	651	712	773	835	896
49	49	109	169	229	289	349	410	470	531	591	652	713	774	836	897
50	50	110	170	230	290	350	411	471	532	592	653	714	775	837	898
51	51	111	171	231	291	351	412	472	533	593	654	715	776	838	899
52	52	112	172	232	292	352	413	473	534	594	655	716	777	839	900
53	53	113	173	233	293	353	414	474	535	595	656	717	778	840	901
54	54	114	174	234	294	354	415	475	536	596	657	718	779	841	902
55	55	115	175	235	295	355	416	476	537	597	658	719	780	842	903
56	56	116	176	236	296	356	417	477	538	598	659	720	781	843	904
57	57	117	177	237	297	357	418	478	539	599	660	721	782	844	905
58	58	118	178	238	298	358	419	479	540	600	661	722	783	845	906
59	59	119	179	239	299	359	420	480	541	601	662	723	784	846	907

A Table of Meridional Parts.

Lat.	14d.	15d.	16d.	17d.	18d.	19d.	20d.	21d.	22d.	23d.	24d.	25d.	26d.	27d.	M.
0	848	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	1684	0
1	849	911	974	1036	1099	1162	1226	1290	1355	1420	1485	1551	1617	1685	1
2	851	913	975	1037	1100	1163	1227	1291	1356	1421	1486	1552	1618	1686	2
3	852	914	976	1038	1101	1164	1228	1292	1357	1422	1487	1553	1619	1687	3
4	853	915	977	1039	1102	1165	1229	1293	1358	1423	1488	1554	1620	1688	4
5	854	916	978	1040	1103	1166	1230	1294	1359	1424	1489	1555	1621	1689	5
6	855	917	979	1041	1104	1167	1231	1295	1360	1425	1490	1556	1622	1690	6
7	856	918	980	1042	1105	1168	1232	1296	1361	1426	1491	1557	1623	1691	7
8	857	919	981	1043	1106	1169	1233	1297	1362	1427	1492	1558	1624	1692	8
9	858	920	982	1044	1107	1170	1234	1298	1363	1428	1493	1559	1625	1693	9
10	859	921	983	1045	1108	1171	1235	1299	1364	1429	1494	1560	1626	1694	10
11	860	922	984	1046	1109	1172	1236	1300	1365	1430	1495	1561	1627	1695	11
12	861	923	985	1047	1110	1173	1237	1301	1366	1431	1496	1562	1628	1696	12
13	862	924	986	1048	1111	1174	1238	1302	1367	1432	1497	1563	1629	1697	13
14	863	925	987	1049	1112	1175	1239	1303	1368	1433	1498	1564	1630	1698	14
15	864	926	988	1050	1113	1176	1240	1304	1369	1434	1499	1565	1631	1699	15
16	865	927	989	1051	1114	1177	1241	1305	1370	1435	1500	1566	1632	1700	16
17	866	928	990	1052	1115	1178	1242	1306	1371	1436	1501	1567	1633	1701	17
18	867	929	991	1053	1116	1179	1243	1307	1372	1437	1502	1568	1634	1702	18
19	868	930	992	1054	1117	1180	1244	1308	1373	1438	1503	1569	1635	1703	19
20	869	931	993	1055	1118	1181	1245	1309	1374	1439	1504	1570	1636	1704	20
21	870	932	994	1056	1119	1182	1246	1310	1375	1440	1505	1571	1637	1705	21
22	871	933	995	1057	1120	1183	1247	1311	1376	1441	1506	1572	1638	1706	22
23	872	934	996	1058	1121	1184	1248	1312	1377	1442	1507	1573	1639	1707	23
24	873	935	997	1059	1122	1185	1249	1313	1378	1443	1508	1574	1640	1708	24
25	874	936	998	1060	1123	1186	1250	1314	1379	1444	1509	1575	1641	1709	25
26	875	937	999	1061	1124	1187	1251	1315	1380	1445	1510	1576	1642	1710	26
27	876	938	1000	1062	1125	1188	1252	1316	1381	1446	1511	1577	1643	1711	27
28	877	939	1001	1063	1126	1189	1253	1317	1382	1447	1512	1578	1644	1712	28
29	878	940	1002	1064	1127	1190	1254	1318	1383	1448	1513	1579	1645	1713	29
30	879	941	1003	1065	1128	1191	1255	1319	1384	1449	1514	1580	1646	1714	30
31	880	942	1004	1066	1129	1192	1256	1320	1385	1450	1515	1581	1647	1715	31
32	881	943	1005	1067	1130	1193	1257	1321	1386	1451	1516	1582	1648	1716	32
33	882	944	1006	1068	1131	1194	1258	1322	1387	1452	1517	1583	1649	1717	33
34	883	945	1007	1069	1132	1195	1259	1323	1388	1453	1518	1584	1650	1718	34
35	884	946	1008	1070	1133	1196	1260	1324	1389	1454	1519	1585	1651	1719	35
36	885	947	1009	1071	1134	1197	1261	1325	1390	1455	1520	1586	1652	1720	36
37	886	948	1010	1072	1135	1198	1262	1326	1391	1456	1521	1587	1653	1721	37
38	887	949	1011	1073	1136	1199	1263	1327	1392	1457	1522	1588	1654	1722	38
39	888	950	1012	1074	1137	1200	1264	1328	1393	1458	1523	1589	1655	1723	39
40	889	951	1013	1075	1138	1201	1265	1329	1394	1459	1524	1590	1656	1724	40
41	890	952	1014	1076	1139	1202	1266	1330	1395	1460	1525	1591	1657	1725	41
42	891	953	1015	1077	1140	1203	1267	1331	1396	1461	1526	1592	1658	1726	42
43	892	954	1016	1078	1141	1204	1268	1332	1397	1462	1527	1593	1659	1727	43
44	893	955	1017	1079	1142	1205	1269	1333	1398	1463	1528	1594	1660	1728	44
45	894	956	1018	1080	1143	1206	1270	1334	1399	1464	1529	1595	1661	1729	45
46	895	957	1019	1081	1144	1207	1271	1335	1400	1465	1530	1596	1662	1730	46
47	896	958	1020	1082	1145	1208	1272	1336	1401	1466	1531	1597	1663	1731	47
48	897	959	1021	1083	1146	1209	1273	1337	1402	1467	1532	1598	1664	1732	48
49	898	960	1022	1084	1147	1210	1274	1338	1403	1468	1533	1599	1665	1733	49
50	899	961	1023	1085	1148	1211	1275	1339	1404	1469	1534	1600	1666	1734	50
51	900	962	1024	1086	1149	1212	1276	1340	1405	1470	1535	1601	1667	1735	51
52	901	963	1025	1087	1150	1213	1277	1341	1406	1471	1536	1602	1668	1736	52
53	902	964	1026	1088	1151	1214	1278	1342	1407	1472	1537	1603	1669	1737	53
54	903	965	1027	1089	1152	1215	1279	1343	1408	1473	1538	1604	1670	1738	54
55	904	966	1028	1090	1153	1216	1280	1344	1409	1474	1539	1605	1671	1739	55
56	905	967	1029	1091	1154	1217	1281	1345	1410	1475	1540	1606	1672	1740	56
57	906	968	1030	1092	1155	1218	1282	1346	1411	1476	1541	1607	1673	1741	57
58	907	969	1031	1093	1156	1219	1283	1347	1412	1477	1542	1608	1674	1742	58
59	908	970	1032	1094	1157	1220	1284	1348	1413	1478	1543	1609	1675	1743	59
60	909	971	1033	1095	1158	1221	1285	1349	1414	1479	1544	1610	1676	1744	60
61	910	972	1034	1096	1159	1222	1286	1350	1415	1480	1545	1611	1677	1745	61

A Table of Meridional Parts.

M	28d.	29d.	30d.	31d.	32d.	33d.	34d.	35d.	36d.	37d.	38d.	39d.	40d.	41d.	M
0	1751	1819	1888	1958	2028	2100	2171	2244	2318	2393	2468	2545	2623	2702	0
1	52	21	90	59	30	01	73	45	19	94	70	46	24	03	1
2	53	22	91	60	31	02	74	47	20	95	71	48	25	04	2
3	55	23	92	62	32	03	75	48	22	96	72	49	27	06	3
4	56	24	93	63	34	04	76	49	23	98	73	50	28	07	4
5	57	25	94	64	35	05	78	50	24	99	75	51	29	08	5
6	57	26	95	65	36	07	79	52	25	2400	76	53	31	10	6
7	59	27	96	66	37	08	80	53	27	01	77	54	32	11	7
8	60	29	98	67	38	09	81	54	28	03	78	55	33	12	8
9	61	30	99	69	39	10	82	55	29	04	80	57	34	14	9
10	1762	1831	1900	1970	2040	2111	2184	2256	2330	2405	2481	2558	2636	2715	10
11	64	32	01	71	41	13	85	58	32	06	82	59	37	16	11
12	65	33	02	72	43	14	86	59	33	08	84	60	38	18	12
13	66	34	03	73	44	15	87	60	34	09	85	62	40	19	13
14	67	35	05	74	45	16	88	61	35	10	86	63	41	20	14
15	68	37	06	76	46	17	90	63	37	11	87	64	42	22	15
16	69	38	07	77	47	19	91	64	38	13	89	66	44	23	16
17	70	39	08	78	48	20	92	65	39	14	90	67	45	24	17
18	72	40	09	79	50	21	93	66	40	15	91	68	46	26	18
19	73	41	10	80	51	22	94	68	42	16	92	69	48	27	19
20	1774	1842	1911	1981	2052	2123	2196	2269	2343	2418	2494	2571	2649	2728	20
21	75	43	13	83	53	25	97	70	44	19	95	72	50	29	21
22	76	45	14	84	54	26	98	71	4	20	96	73	51	31	22
23	77	46	15	85	56	27	99	72	46	21	98	75	53	32	23
24	78	47	16	86	57	28	2000	74	48	23	99	76	54	33	24
25	80	48	17	87	58	29	02	75	49	24	2500	77	55	35	25
26	81	49	18	88	59	31	03	76	50	25	01	78	57	36	26
27	82	50	20	90	60	32	04	77	51	27	03	80	58	37	27
28	83	52	21	91	61	33	05	79	53	28	04	81	59	39	28
29	84	53	22	92	63	34	07	80	54	29	05	82	61	40	29
30	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	2584	2662	2742	30
31	86	55	24	94	65	37	09	82	56	32	08	85	63	43	31
32	87	56	25	95	66	38	10	83	58	33	09	86	65	44	32
33	89	57	27	97	67	39	11	85	59	34	10	88	66	46	33
34	90	58	28	98	69	40	13	86	60	35	12	89	67	47	34
35	91	60	29	99	70	41	14	87	61	37	13	90	69	48	35
36	92	61	30	2000	71	43	15	88	63	38	14	91	70	50	36
37	93	62	31	01	72	44	16	90	64	39	15	93	71	51	37
38	94	63	32	02	73	45	17	91	65	40	17	94	73	52	38
39	96	64	34	04	75	46	19	92	66	42	18	95	74	54	39
40	1797	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	2597	2675	2755	40
41	98	66	36	06	77	49	21	95	69	44	21	98	76	56	41
42	99	68	37	07	78	50	22	96	70	45	22	99	78	58	42
43	1800	69	38	08	79	51	24	97	71	47	23	2601	79	59	43
44	01	70	39	10	80	52	25	98	73	48	24	02	80	60	44
45	02	71	41	11	82	53	26	99	74	49	26	03	81	62	45
46	03	72	42	12	83	55	27	2301	75	51	27	04	82	63	46
47	05	73	43	13	84	56	28	02	76	52	28	06	84	64	47
48	06	75	44	14	85	57	30	03	78	53	30	07	86	66	48
49	07	76	45	15	86	58	31	04	79	54	31	08	87	67	49
50	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	2610	2688	2768	50
51	09	78	48	18	89	61	33	07	81	57	33	11	90	70	51
52	10	79	49	19	90	62	35	08	83	58	35	12	91	71	52
53	11	80	50	20	91	63	36	09	84	59	36	14	92	72	53
54	13	81	51	21	92	64	37	11	85	61	37	15	94	74	54
55	14	83	52	22	94	65	38	12	86	62	38	16	95	75	55
56	15	84	53	24	95	67	39	13	88	63	40	17	96	76	56
57	16	85	55	25	96	68	41	14	89	64	41	19	98	78	57
58	17	86	56	26	97	69	42	16	90	66	42	20	99	79	58
59	18	87	57	27	98	70	43	17	91	67	44	21	2700	80	59

A Table of Meridional Parts.

M.	42d.	43d.	44d.	45d.	46d.	47d.	48d.	49d.	50d.	51d.	52d.	53d.	54d.	55d.	M.
0	2782	2862	2946	3030	3116	3203	3292	3382	3474	3569	3665	3764	3865	3968	0
1	83	64	47	31	17	04	93	84	76	70	67	65	66	70	1
2	84	66	49	33	18	06	95	85	78	72	68	67	68	71	2
3	86	67	50	34	20	07	96	87	79	74	70	69	70	73	3
4	87	69	51	36	21	09	98	88	81	75	72	70	71	75	4
5	88	70	53	37	23	10	99	90	82	77	73	72	73	77	5
6	90	71	54	38	24	12	3301	91	84	78	75	74	75	78	6
7	91	73	56	40	26	13	02	93	85	80	77	75	77	80	7
8	92	74	57	41	27	14	03	94	87	82	78	77	78	82	8
9	94	75	58	43	29	16	05	96	88	83	80	79	80	84	9
10	2795	2877	2960	3044	3130	3217	3306	3397	3490	3585	3681	3780	3882	3985	10
11	97	78	61	45	31	19	08	99	92	86	83	82	83	87	11
12	98	80	63	47	33	20	09	3400	93	88	85	84	85	89	12
13	99	81	64	48	34	22	11	02	95	90	86	85	87	91	13
14	2801	82	65	50	36	23	12	03	96	91	88	87	89	92	14
15	02	84	67	51	37	25	14	05	98	93	90	89	90	94	15
16	03	85	68	53	39	26	16	07	99	94	91	90	92	96	16
17	05	86	70	54	40	28	17	08	3501	96	93	92	94	98	17
18	06	88	71	55	42	29	19	10	03	98	95	94	95	99	18
19	07	89	72	57	43	31	20	11	04	99	96	95	97	4001	19
20	2809	2891	2974	3058	3144	3232	3322	3413	3506	3601	3695	3797	3899	4003	20
21	10	92	75	60	46	34	23	14	07	02	99	99	3901	05	21
22	11	93	76	61	47	35	25	16	09	04	3701	3800	02	06	22
23	13	95	78	63	49	37	26	17	10	06	03	02	04	08	23
24	14	96	79	64	50	38	28	19	12	07	04	04	06	10	24
25	15	97	81	65	52	40	29	20	14	09	06	06	07	12	25
26	17	99	82	67	53	41	31	22	15	10	08	07	09	14	26
27	18	2900	83	68	55	42	32	23	17	12	09	09	11	15	27
28	20	01	85	70	56	44	34	25	18	14	11	11	13	17	28
29	21	03	86	71	57	45	35	27	20	15	13	12	14	19	29
30	2822	2904	2988	3073	3159	3247	3337	3428	3521	3617	3714	3814	3916	4021	30
31	24	06	89	74	60	48	38	30	23	18	16	16	18	22	31
32	25	07	91	75	62	50	40	31	25	20	17	17	19	24	32
33	26	08	92	77	63	51	41	33	26	22	19	19	21	26	33
34	28	10	93	78	65	53	43	34	28	23	21	21	23	28	34
35	29	11	95	80	66	54	44	36	29	25	22	22	25	29	35
36	30	13	96	81	68	56	46	37	31	26	24	24	26	31	36
37	32	14	98	83	69	57	47	39	32	28	26	26	28	33	37
38	33	15	99	84	71	59	49	40	34	30	27	27	30	35	38
39	34	17	3000	85	72	60	50	42	36	31	29	29	32	37	39
40	2836	2918	3002	3087	3173	3262	3352	3443	3537	3633	3731	3831	3933	4038	40
41	37	19	03	88	75	63	53	45	39	34	32	32	35	40	41
42	39	21	05	90	76	65	55	47	40	36	34	34	37	42	42
43	40	22	06	91	78	66	56	48	42	38	36	36	38	44	43
44	41	24	07	93	79	68	58	50	43	39	37	38	40	45	44
45	43	25	09	94	81	69	59	51	45	41	39	39	42	47	45
46	44	26	10	95	82	71	61	53	47	43	41	41	44	49	46
47	45	28	12	97	84	72	62	54	48	44	42	43	45	51	47
48	47	29	13	98	85	74	64	56	50	46	44	44	47	52	48
49	48	31	14	3100	87	75	65	57	51	47	46	46	49	54	49
50	2849	2932	3016	3101	3188	3277	3367	3459	3553	3649	3747	3848	3951	4056	50
51	51	33	17	03	90	78	68	60	55	51	49	49	52	58	51
52	52	35	19	04	91	80	70	62	56	52	50	51	54	60	52
53	54	36	20	06	92	81	71	64	58	54	52	53	56	61	53
54	55	37	21	07	94	83	73	65	59	55	54	55	58	63	54
55	56	39	23	08	95	84	74	67	61	57	55	56	59	65	55
56	58	40	24	10	97	86	76	68	62	59	57	58	61	67	56
57	59	42	26	11	98	87	78	70	64	60	59	60	63	69	57
58	60	43	27	13	3200	89	79	71	66	61	60	61	64	70	58
59	62	44	28	14	01	90	81	73	67	62	61	62	66	72	59

A Table of Meridional Parts.

M.	56d.	57d.	58d.	59d.	60d.	61d.	62d.	63d.	64d.	65d.	66d.	67d.	68d.	69d.	M.
0	4074	4183	4294	4409	4527	4649	4775	4905	5039	5179	5324	5474	5631	5795	0
1	76	84	96	11	29	51	77	07	42	81	26	77	33	97	1
2	78	86	98	13	31	53	79	09	44	84	28	79	36	5800	2
3	79	88	4300	15	33	55	81	12	46	86	31	82	39	03	3
4	81	90	02	17	35	57	84	14	49	88	33	84	41	06	4
5	83	92	04	19	37	60	86	16	51	91	36	87	44	09	5
6	85	94	06	21	39	62	88	18	53	93	38	89	47	11	6
7	86	95	08	23	41	64	90	20	55	95	41	92	50	14	7
8	88	97	09	25	43	66	92	23	56	98	43	95	52	17	8
9	90	99	11	27	45	68	94	25	60	5200	46	97	55	20	9
10	4092	4201	4313	4429	4547	4670	4796	4927	5062	5203	5348	5500	5658	5823	10
11	94	03	15	31	49	72	98	29	65	05	51	02	60	25	11
12	95	05	17	33	51	74	4801	31	67	07	53	05	63	28	12
13	97	07	19	34	53	76	03	34	69	10	56	07	66	31	13
14	99	08	21	36	55	78	05	36	71	12	58	10	68	34	14
15	4101	10	23	38	57	80	07	38	74	14	61	13	71	37	15
16	03	12	25	40	59	82	09	40	76	17	63	15	74	39	16
17	04	14	27	42	61	84	11	43	78	19	66	18	76	42	17
18	06	16	28	44	64	87	14	45	81	22	68	20	79	45	18
19	08	18	30	46	66	89	16	47	83	24	71	23	82	48	19
20	4110	4220	4332	4448	4568	4691	4818	4949	5085	5226	5373	5526	5685	5851	20
21	12	21	34	50	70	93	20	51	88	29	76	28	87	54	21
22	13	23	36	52	72	95	22	53	90	31	78	31	90	56	22
23	15	25	38	54	74	97	24	56	92	34	80	33	93	59	23
24	17	27	40	56	76	99	26	58	95	36	83	36	95	62	24
25	19	29	42	58	78	4701	29	60	97	38	85	39	98	65	25
26	21	31	44	60	80	03	31	63	99	41	88	41	5701	68	26
27	22	32	46	62	82	05	33	65	5102	43	90	44	04	71	27
28	24	34	47	64	84	07	35	67	04	46	93	46	06	74	28
29	26	36	49	66	86	10	37	69	06	48	95	49	09	76	29
30	4128	4238	4351	4468	4588	4712	4839	4971	5108	5250	5398	5552	5712	5879	30
31	30	40	53	70	90	11	43	73	11	53	5401	54	15	82	31
32	32	42	55	72	92	13	44	76	13	55	03	57	17	85	32
33	33	44	57	74	94	15	46	78	15	58	06	59	20	88	33
34	35	46	59	76	96	17	48	81	17	60	08	62	23	91	34
35	37	47	61	78	98	19	50	83	19	63	11	65	25	94	35
36	39	49	63	80	4600	24	52	85	22	65	13	67	28	96	36
37	41	51	65	82	02	26	55	87	25	67	16	70	31	99	37
38	42	53	67	84	04	28	57	90	27	70	18	73	34	5902	38
39	44	55	69	86	06	31	59	92	30	72	21	75	36	05	39
40	4146	4257	4370	4488	4608	4733	4861	4994	5132	5275	5423	5578	5739	5908	40
41	48	59	72	90	10	35	63	96	34	77	26	80	42	11	41
42	50	60	74	92	12	37	65	99	36	80	28	83	45	14	42
43	52	62	76	94	14	39	68	5001	39	82	31	86	47	17	43
44	53	64	78	96	16	41	70	03	41	84	33	88	50	19	44
45	55	66	80	97	18	43	72	05	43	87	36	91	53	22	45
46	57	68	82	99	20	45	74	08	46	89	38	94	56	25	46
47	59	70	84	4501	23	47	76	10	48	92	41	96	58	28	47
48	61	72	86	03	25	50	79	12	51	94	43	99	61	31	48
49	62	74	88	05	27	52	81	14	53	97	46	5602	64	34	49
50	4164	4275	4390	4507	4629	4754	4883	5017	5155	5299	5448	5604	5767	5937	50
51	66	77	92	09	31	56	85	19	58	5301	51	07	70	40	51
52	68	79	94	11	33	58	87	21	60	04	54	10	72	43	52
53	70	81	96	13	35	60	90	23	62	06	56	12	75	46	53
54	72	83	98	15	37	62	92	25	65	09	59	15	78	48	54
55	73	85	99	17	39	64	94	28	67	11	61	17	81	51	55
56	75	87	4401	19	41	66	96	30	69	14	64	20	83	54	56
57	77	89	03	21	43	69	98	33	72	16	66	23	86	57	57
58	79	91	05	23	45	71	4901	35	74	19	69	25	89	60	58
59	81	93	07	25	47	73	03	37	76	21	71	28	92	63	59

A Table of Meridional Parts.

M.	70d.	71d.	72d.	73d.	74d.	75d.	76d.	77d.	78d.	79d.	80d.	81d.	82d.	83d.	M.
0	5966	6146	6335	6534	6746	6970	7210	7467	7745	8046	8375	8739	9145	9606	0
1	69	49	38	38	49	74	14	72	49	51	81	45	53	14	1
2	72	52	41	41	53	78	18	76	54	56	87	52	60	22	2
3	75	55	45	45	57	82	22	81	59	61	93	58	67	31	3
4	78	58	48	48	60	86	27	85	64	67	98	65	74	39	4
5	81	61	51	52	64	90	31	90	69	72	8404	71	82	47	5
6	84	64	54	55	68	94	35	94	74	77	10	78	89	55	6
7	86	67	58	58	71	97	39	98	78	83	16	84	96	64	7
8	89	70	61	62	75	7001	43	7503	83	88	22	91	9203	72	8
9	92	73	64	65	79	05	47	07	88	93	27	97	11	80	9
10	5995	6177	6367	6569	6782	7009	7252	7512	7793	8099	8433	8804	9218	9689	10
11	98	80	71	72	86	13	56	16	98	8104	39	10	25	97	11
12	6001	83	74	76	90	17	60	21	7803	09	45	17	33	9706	12
13	04	86	77	79	93	21	64	25	08	15	51	23	40	14	13
14	07	89	80	83	97	25	68	30	13	20	57	30	48	23	14
15	10	92	84	86	6801	29	73	35	17	25	63	36	55	31	15
16	13	95	87	90	04	33	77	39	22	31	69	43	62	40	16
17	16	98	90	93	08	37	81	44	27	36	74	49	70	48	17
18	19	6201	94	96	12	41	85	48	32	41	80	56	77	57	18
19	22	05	97	6600	15	45	89	53	37	47	86	63	85	65	19
20	6025	6208	6400	6603	6819	7049	7294	7557	7842	8152	8492	8869	9292	9774	20
21	28	11	03	07	23	52	98	62	47	58	98	76	9300	83	21
22	31	14	07	10	26	56	7302	66	52	63	8504	83	07	91	22
23	34	17	10	14	30	60	06	71	57	68	10	89	15	9800	23
24	37	20	13	17	34	64	11	76	62	74	16	96	22	09	24
25	40	23	17	21	38	68	15	80	67	79	22	8903	30	17	25
26	43	26	20	24	41	72	19	85	72	85	28	09	37	26	26
27	46	30	23	28	45	76	23	89	77	90	34	16	45	35	27
28	49	33	27	31	49	80	28	94	82	96	40	23	53	44	28
29	52	36	30	35	53	84	32	98	87	8201	46	30	60	52	29
30	6055	6239	6433	6639	6856	7088	7336	7603	7892	8207	8552	8936	9368	9861	30
31	58	42	37	42	60	92	41	08	97	12	58	43	76	70	31
32	61	45	40	46	64	96	45	12	7902	18	65	50	83	79	32
33	64	49	43	49	68	7100	49	17	07	23	71	57	91	80	33
34	67	52	47	53	71	04	53	22	12	29	77	63	99	97	34
35	70	55	50	56	75	08	58	26	17	34	83	70	9407	9906	35
36	73	58	53	60	79	12	62	31	22	40	89	77	14	15	36
37	76	61	57	63	83	16	66	36	27	45	95	84	22	24	37
38	79	64	60	67	86	20	71	40	32	51	8601	91	30	33	38
39	82	68	63	70	90	24	75	45	37	56	07	98	38	42	39
40	6085	6271	6467	6674	6894	7128	7379	7650	7942	8262	8614	9005	9445	9951	40
41	88	74	70	77	98	32	84	54	48	67	20	12	53	59	41
42	91	77	73	81	6901	36	88	59	53	73	26	18	61	69	42
43	94	80	77	85	05	40	92	64	58	79	32	25	69	78	43
44	97	83	80	88	09	45	97	68	63	84	38	32	77	87	44
45	6100	87	83	92	13	49	7401	73	68	90	44	39	85	9996	45
46	03	90	87	95	17	53	06	78	73	95	51	46	93	10005	46
47	06	93	90	99	20	57	10	83	78	8301	57	53	9501	10015	47
48	09	96	94	6702	24	61	14	87	83	07	63	60	09	10024	48
49	12	99	97	06	28	65	19	92	89	12	69	67	17	10033	49
50	6115	6303	6500	6710	6932	7269	7423	7697	7994	8218	8676	9074	9525	10043	50
51	18	06	04	13	36	73	27	7702	99	24	82	81	33	10052	51
52	21	09	07	17	40	77	32	06	8004	29	88	88	41	10061	52
53	24	12	11	20	43	81	36	11	09	35	95	96	49	10071	53
54	27	15	14	24	47	85	41	16	14	41	8701	9102	57	10080	54
55	30	19	17	28	51	89	45	21	20	47	07	10	65	10089	55
56	33	22	21	31	55	94	49	25	25	52	14	17	73	10099	56
57	36	25	24	35	59	98	54	30	30	58	20	24	81	10108	57
58	40	28	28	38	63	7202	58	35	35	64	26	31	89	10118	58
59	43	32	31	42	66	06	63	40	40	69	33	38	98	10127	59

A T A B L E for finding the H O U R.

M	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rifing.	Cn. ar.	M	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rifing.
0	30	2.66121	2.63982	9.37654		30	30	6.87717	4.42386	2.94656
1	00	2.36018	2.94085	97860	} Cn. ar.	31	00	87015	43088	96067
1	30	2.18409	3.11694	0.33078		31	30	86324	43779	97454
2	00	2.05916	24187	58066		32	00	85644	44459	98820
2	30	1.96225	33878	77448		32	30	84976	45127	3.00164
3	00	88307	41796	93284		33	00	84317	45786	01488
3	30	81613	48490	1.06673		33	30	83669	46434	02792
4	00	75814	54289	18271		34	00	83030	47073	04077
4	30	70700	69403	28502		34	30	82400	47703	05342
5	00	66125	63978	37653		35	00	81780	48323	06590
5	30	1.61986	3.68117	1.45931		35	30	8.81169	4.48934	3.07819
6	00	58208	71895	53488	} Cn. ar.	36	00	80567	49536	09032
6	30	54733	75370	60440		36	30	79973	50130	10227
7	00	51515	78588	66877		37	00	79387	50716	11406
7	30	48520	81583	72869		37	30	78809	51294	12570
8	00	45718	84385	78474		38	00	78239	51864	13718
8	30	43086	87017	83739		38	30	77677	52426	14850
9	00	40605	89498	88703		39	00	77122	52981	15969
9	30	38258	91845	93399		39	30	76574	53529	17072
10	00	36032	94071	97854		40	00	76033	54070	18162
10	30	1.33915	3.96188	2.02091		40	30	0.75499	4.54604	3.19238
11	00	31896	98207	06131	} Cn. ar.	41	00	74972	55131	20301
11	30	29967	4.00136	09991		41	30	74451	55652	21351
12	00	28120	01983	13687		42	00	73937	56166	22389
12	30	26349	03754	17232		42	30	73429	56674	23414
13	00	24647	05456	20658		43	00	72926	57176	24427
13	30	23010	07093	23915		43	30	72430	57673	25428
14	00	21432	08671	27073		44	00	71940	58163	26418
14	30	19910	10193	30120		44	30	71455	58648	27396
15	00	18440	11663	33063		45	00	70976	59127	28363
15	30	1.17018	4.13085	2.35910		45	30	0.70503	4.59600	3.29320
16	00	15642	14461	38667	} Cn. ar.	46	00	70034	60069	30266
16	30	14307	15796	41338		46	30	69571	60532	31202
17	00	13013	17090	43930		47	00	69113	60990	32128
17	30	11757	18346	46447		47	30	68660	61443	33044
18	00	10536	19567	48893		48	00	68212	61891	33950
18	30	09348	20755	51271		48	30	67769	62334	34847
19	00	08193	21910	53586		49	00	67330	62773	35734
19	30	07067	23036	55841		49	30	66896	63207	36613
20	00	05970	24133	58039		50	00	66406	63637	37482
20	30	1.04901	4.25202	2.60182		50	30	0.66641	4.64062	2.38343
21	00	03857	26246	62274	} Cn. ar.	51	00	65620	64483	39195
21	30	02838	27265	64316		51	30	65204	64899	40039
22	00	01843	28260	66312		52	00	64791	65312	40875
22	30	00870	29233	68262		52	30	64383	65720	41702
23	00	0.99918	30185	70170		53	00	63978	66125	42523
23	30	98988	31115	72036		53	30	63578	66525	43334
24	00	98077	32026	73863		54	00	63181	66922	44138
24	30	97184	32919	75652		54	30	62789	67314	44935
25	00	96310	33793	77505		55	00	62400	67703	45724
25	30	0.95454	4.34649	2.79124		55	30	0.62014	4.68089	3.46507
26	00	94614	35489	80809	} Cn. ar.	56	00	61632	68471	47282
26	30	93791	36313	82461		56	30	61254	68849	48050
27	00	92982	37121	84083		57	00	60879	69214	48811
27	30	92189	37914	85675		57	30	60508	69595	49566
28	00	91411	38692	87238		58	00	60140	69963	50314
28	30	90646	39457	88773		58	30	59775	70328	51056
29	00	89894	40209	90282		59	00	59414	70689	51791
29	30	89156	40947	91765		59	30	59056	71047	52520
30	00	88430	41673	93223		60	00	58700	71403	53243

LATITUDE by two Altitudes. I H O U R.

M	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rifings.	M	S.	$\frac{1}{2}$ Elapl. Time.	Middle Time.	Rifing.
00	30	0.58348	4.71755	3.53959	30	30	0.41488	4.88615	3.88625
01	00	57999	72104	54070	31	00	41261	88842	89097
01	30	57653	72450	55375	31	30	41030	89067	89567
02	00	57310	72793	56074	32	00	40812	89291	90034
02	30	56970	73133	56767	32	30	40590	89513	90498
03	00	56633	73470	57455	33	00	40368	89734	90960
03	30	56298	73805	58137	33	30	40149	89954	91420
04	00	55966	74137	58814	34	00	39930	90173	91876
04	30	55637	74466	59486	34	30	39713	90390	92331
05	00	55311	74792	60152	35	00	39497	90606	92782
05	30	0.54987	4.75116	3.60813	35	30	0.39282	4.90821	3.93232
06	00	54606	75437	61469	36	00	39069	91034	93679
06	30	54347	75756	62120	36	30	38856	91247	94123
07	00	54031	76072	62766	37	00	38646	91457	94566
07	30	53718	76385	63407	37	30	38436	91667	95005
08	00	53406	76697	64043	38	00	38227	91876	95443
08	30	53097	77005	64675	38	30	38020	92083	95878
09	00	52791	77312	65302	39	00	37814	92289	96311
09	30	52487	77616	65924	39	30	37609	92494	96742
10	00	52186	77917	66542	40	00	37405	92698	97170
10	30	0.51886	4.78217	3.67150	40	30	0.37203	4.92900	3.97597
11	00	51589	78514	67705	41	00	37001	93102	98021
11	30	51294	78809	68369	41	30	36801	93301	98443
12	00	51002	79101	68969	42	00	36602	93501	98862
12	30	50711	79392	69566	42	30	36403	93700	99280
13	00	50423	79680	70158	43	00	36206	93897	99696
13	30	50137	79966	70745	43	30	36011	94097	4.00109
14	00	49852	80251	71329	44	00	35816	94287	00521
14	30	49570	80533	71909	44	30	35622	94481	00930
15	00	49290	80813	72485	45	00	35429	94673	01337
15	30	0.49012	4.81091	3.73057	45	30	0.35238	4.94865	4.01743
16	00	48736	81367	73625	46	00	35047	95056	02146
16	30	48462	81641	74189	46	30	34858	95245	02547
17	00	48189	81914	74750	47	00	34669	95434	02947
17	30	47919	82184	75307	47	30	34482	95621	03344
18	00	47650	82453	75860	48	00	34295	95808	03740
18	30	47384	82719	76409	48	30	34110	95993	04134
19	00	47119	82984	76955	49	00	33925	96178	04526
19	30	46856	83247	77498	49	30	33742	96301	04916
20	00	46595	83508	78037	50	00	33559	96544	05304
20	30	0.46335	4.83768	3.78573	50	30	0.33378	4.96725	4.05690
21	00	46078	84025	79105	51	00	33197	96906	06074
21	30	45822	84281	79634	51	30	33018	97085	06457
22	00	45567	84536	80159	52	00	32839	97264	06838
22	30	45315	84788	80682	52	30	32661	97442	07217
23	00	45064	85039	81201	53	00	32485	97618	07595
23	30	44815	85288	81717	53	30	32309	97794	07970
24	00	44567	85536	82230	54	00	32134	97969	08344
24	30	44321	85782	82739	54	30	31960	98143	08716
25	00	44077	86026	83240	55	00	31787	98316	09087
25	30	0.43834	4.86269	3.83749	55	30	0.31614	4.98489	4.09456
26	00	43592	86511	84250	56	00	31443	98660	09823
26	30	43353	86750	84748	56	30	31272	98831	10188
27	00	43114	86989	85242	57	00	31103	99000	10552
27	30	42878	87225	85734	57	30	30934	99169	10914
28	00	42642	87461	86223	58	00	30766	99337	11275
28	30	42409	87694	86709	58	30	30599	99504	11634
29	00	42176	87927	87192	59	00	30433	99670	11992
29	30	41945	88158	87672	59	30	30268	99835	12348
30	00	41716	88387	88150	60	00	30103	5.00000	12702

A T A B L E for finding the- 2 H O U R S.

M S.	$\frac{1}{2}$ Elapf. Time.	Middle Time.	Rifing.	M S.	$\frac{1}{2}$ Elapf. Time.	Middle Time.	Rifing.
01 30	0. 29939	5. 00164	4. 13055	30 30	0. 21432	5. 08671	4. 31801
01 00	29776	00327	13400	31 00	21309	08794	32079
01 30	29614	00489	13756	31 30	21187	08916	32355
02 00	29453	00650	14104	32 00	21066	09037	32631
02 30	29293	00810	14451	32 30	20945	09158	32906
03 00	29133	00970	14797	33 00	20824	09279	33180
03 30	28974	01129	15140	33 30	20704	09399	33452
04 00	28816	01287	15483	34 00	20585	09518	33724
04 30	28659	01444	15824	34 30	20466	09637	33995
05 00	28502	01601	16163	35 00	20348	09755	34265
05 30	0. 28346	5. 01757	4. 16501	35 30	0. 20230	5. 09873	4. 34534
06 00	28191	01912	16838	36 00	20113	09990	34802
06 30	28037	02066	17173	36 30	19996	10107	35069
07 00	27884	02219	17507	37 00	19880	10223	35335
07 30	27731	02372	17839	37 30	19764	10339	35600
08 00	27579	02524	18171	38 00	19648	10454	35865
08 30	27428	02675	18500	38 36	19534	10569	36128
09 00	27277	02826	18829	39 00	19420	10683	36391
09 30	27127	02976	19156	39 30	19306	10797	36652
10 00	26978	03125	19482	40 00	19193	10910	36913
10 30	0. 26830	5. 03273	4. 19806	40 30	0. 19080	5. 11023	4. 37173
11 00	26682	03421	20129	41 00	18968	11135	37432
11 30	26535	03568	20451	41 30	18857	11246	37690
12 00	26389	03714	20771	42 00	18746	11357	37948
12 30	26244	03859	21091	42 30	18635	11468	38204
13 00	26099	04004	21409	43 00	18525	11578	38460
13 30	25955	04148	21725	43 30	18415	11688	38714
14 00	25811	04292	22041	44 00	18306	11797	38968
14 30	25668	04435	22355	44 30	18197	11906	39221
15 00	25526	04577	22668	45 00	18089	12014	39473
15 30	0. 25385	5. 04718	4. 22980	45 30	0. 17981	5. 12122	4. 39724
16 00	25244	04859	23290	46 00	17874	12229	39975
16 30	25104	04999	23599	46 30	17767	12336	40225
17 00	24964	05139	23907	47 00	17660	12443	40474
17 30	24825	05278	24214	47 30	17554	12549	40722
18 00	24687	05416	24520	48 00	17449	12654	40969
18 30	24550	05553	24825	48 30	17344	12759	41215
19 00	24413	05690	25128	49 00	17239	12864	41461
19 30	24277	05826	25430	49 30	17135	12968	41706
20 00	24141	05962	25731	50 00	17031	13071	41950
20 30	0. 24006	5. 06097	4. 26031	50 30	0. 16928	5. 13174	4. 42193
21 00	23871	06232	26330	51 00	16826	13277	42435
21 30	23738	06365	26628	51 30	16724	13379	42677
22 00	23605	06498	26924	52 00	16622	13481	42918
22 30	23472	06631	27220	52 30	16520	13583	43158
23 00	23340	06763	27514	53 00	16419	13684	43398
23 30	23209	06894	27807	53 30	16319	13784	43636
24 00	23078	07025	28099	54 00	16219	13884	43874
24 30	22948	07155	28391	54 30	16119	13984	44111
25 00	22819	07284	28681	55 00	16029	14083	44384
25 30	0. 22690	5. 07413	4. 28969	55 30	0. 15921	5. 14182	4. 44583
26 00	22561	07542	29257	56 00	15823	14280	44818
26 30	22433	07670	29544	56 30	15725	14378	45052
27 00	22306	07797	29830	57 00	15627	14476	45286
27 30	22180	07923	30115	57 30	15530	14573	45518
28 00	22054	08049	30398	58 00	15434	14669	45750
28 30	21928	08175	30681	58 30	15338	14765	45981
29 00	21803	08300	30963	59 00	15242	14861	46212
29 30	21679	08424	31244	59 30	15146	14957	46442
30 00	21555	08548	31523	60 00	15051	15052	46671

LATITUDE by Two Altitudes. 3 H O U R S,

M S.	$\frac{1}{2}$ Elapf. Time.	Middle Time.	Rising.	M S.	$\frac{1}{2}$ Elapf. Time.	Middle Time.	Rising.
00 30	0. 14957	5. 15146	4. 46899	30 30	0. 09981	5. 20122	4. 59436
01 00	14863	15247	47127	31 00	09909	20194	59627
01 30	14769	15334	47354	31 30	09837	20266	59818
02 00	14676	15427	47580	32 00	09766	20338	60008
02 30	14583	15520	47806	32 30	09694	20409	60198
03 00	14490	15613	48031	33 00	09623	20480	60388
03 30	14398	15705	48255	33 30	09552	20551	60577
04 00	14306	15797	48479	34 00	09482	20621	60765
04 30	14215	15888	48702	34 30	09412	20691	60952
05 00	14124	15979	48924	35 00	09342	20760	61139
05 30	0. 14034	5. 16069	4. 49145	35 30	0. 09273	5. 20830	4. 61326
06 00	13944	16159	49366	36 00	09204	20899	61512
06 30	13854	16249	49586	36 30	09135	20968	61698
07 00	13765	16338	49806	37 00	09067	21036	61883
07 30	13676	16427	50025	37 30	08999	21104	62068
08 00	13587	16516	50243	38 00	08931	21172	62252
08 30	13499	16604	50460	38 30	08864	21239	62436
09 00	13411	16692	50677	39 00	08797	21306	62619
09 30	13324	16779	50893	39 30	08730	21373	62802
10 00	13237	16866	51109	40 00	08664	21439	62984
10 30	0. 13150	5. 16953	4. 51324	40 30	0. 08597	5. 21505	4. 63166
11 00	13064	17039	51539	41 00	08531	21571	63347
11 30	12971	17125	51753	41 30	08466	21637	63528
12 00	12893	17210	51966	42 00	08401	21702	63708
12 30	12808	17295	52178	42 30	08336	21767	63888
13 00	12723	17380	52390	43 00	08271	21832	64067
13 30	12638	17465	52601	43 30	08207	21896	64246
14 00	12554	17549	52812	44 00	08143	21960	64425
14 30	12474	17633	53022	44 30	08079	22025	64603
15 00	12487	17716	53231	45 00	08015	22088	64780
15 30	0. 12305	5. 17799	4. 53440	45 30	0007952	5. 22151	4. 64957
16 00	12222	17881	53648	46 00	07884	22214	65134
16 30	12140	17963	53856	46 30	07827	22276	65310
17 00	12058	18045	54063	47 00	07765	22338	65486
17 30	11977	18126	54269	47 30	07703	22400	65661
18 00	11896	18207	54475	48 00	07641	22462	65806
18 30	11815	18288	54680	48 30	07579	22524	66010
19 00	11734	18369	54885	49 00	07518	22585	66184
19 30	11654	18449	55089	49 30	07457	22646	66357
20 00	11574	18529	55293	50 00	07397	22707	66539
20 30	0. 11495	5. 18608	4. 55496	50 30	0. 07337	5. 22766	4. 66702
21 00	11416	18687	55698	51 00	07277	22826	66874
21 30	11337	18766	55900	51 30	07217	22886	67046
22 00	11259	18844	56101	52 00	07158	22945	67217
22 30	11181	18922	56301	52 30	07099	23004	67388
23 00	11104	18999	56501	53 00	07040	23062	67558
23 30	11027	19076	56701	53 30	06981	23123	67728
24 00	10950	19153	56900	54 00	06923	23180	67897
24 30	10873	19230	57098	54 30	06865	23238	68066
25 00	10797	19306	57296	55 00	06808	23295	68235
25 30	0. 10721	5. 19382	4. 57494	55 30	0. 06751	5. 23352	4. 68403
26 00	10645	19458	57690	56 00	06694	23409	68571
26 30	10570	19533	57886	56 30	06637	23466	68738
27 00	10495	19608	58082	57 00	06580	23523	68905
27 30	10421	19682	58277	57 30	06524	23579	69071
28 00	10347	19756	58471	58 00	06468	23635	69237
28 30	10273	19830	58665	58 30	06412	23691	69403
29 00	10199	19904	58859	59 00	06357	23746	69568
29 30	10126	19977	59052	59 30	06302	23801	69733
30 00	10053	10050	59244	60 00	06247	23856	69897

A TABLE for finding the 4 HOURS.

M.S.	Elapl. Time.	Middle Tims.	Rifing.	M.S.	Elapl. Time.	Middle Time.	Rifing.
00 30	0.06192	5.23911	4.70001	30 30	0.03309	5.26704	4.79193
01 00	06138	23965	70224	31 00	03360	26743	79334
01 30	06084	24019	70387	31 30	03321	26782	79475
02 00	06030	24073	70550	32 00	03283	26820	79616
02 30	05977	24126	70712	32 30	03245	26858	79756
03 00	05924	24179	70874	33 00	03207	26896	79896
03 30	05871	24232	71036	33 30	03170	26934	80036
04 00	05818	24285	71197	34 00	03132	26971	80175
04 30	05766	24337	71352	34 30	03095	27008	80314
05 00	05714	24389	71518	35 00	03058	27045	80452
05 30	05661	5.24441	4.71678	35 30	0.03021	5.27082	4.80591
06 00	05610	24493	71837	36 00	02985	27118	80729
06 30	05559	24544	71990	36 30	02949	27154	80867
07 00	05508	24595	72155	37 00	02913	27190	81004
07 30	05457	24646	72313	37 30	02877	27226	81141
08 00	05406	24697	72471	38 00	02841	27262	81278
08 30	05356	24747	72628	38 30	02806	27297	81414
09 00	05306	24797	72786	39 00	02771	27332	81550
09 30	05256	24847	72942	39 30	02736	27367	81686
10 00	05207	24897	73098	40 00	02701	27402	81821
10 30	0.05158	5.24945	4.73254	40 30	0.02667	5.27436	4.81956
11 00	05109	24994	73410	41 00	02633	27470	82091
11 30	05060	2504	73565	41 30	02599	27504	82226
12 00	05012	25091	73720	42 00	02565	27538	82360
12 30	04964	25139	73874	42 30	02532	27571	82494
13 00	04916	25187	74028	43 00	02499	27604	82628
13 30	04868	25235	74182	43 30	02466	27637	82761
14 00	04821	25282	74335	44 00	02433	27670	82894
14 30	04774	25329	74488	44 30	02400	27703	83027
15 00	04727	25376	74641	45 00	02368	27735	83159
15 30	0.04680	5.25423	4.74793	45 30	0.02336	5.27767	4.83291
16 00	04634	25469	74945	46 00	02304	27799	83423
16 30	04588	25515	75096	46 30	02272	27831	83554
17 00	04542	25561	75247	47 00	02241	27862	83685
17 30	04496	25607	75398	47 30	02210	27893	83816
18 00	04451	25652	75549	48 00	02179	27924	83947
18 30	04406	25697	75699	48 30	02148	27955	84077
19 00	04361	25742	75848	49 00	02118	27985	84207
19 30	04316	25787	75997	49 30	02088	28015	84337
20 00	04272	25831	76146	50 00	02058	28045	84466
20 30	0.04228	5.25875	4.76295	50 30	0.02028	5.28075	4.84595
21 00	04184	25919	76443	51 00	01998	28105	84724
21 30	04141	25962	76591	51 30	01969	28134	84853
22 00	04098	26005	76738	52 00	01940	28163	84981
22 30	04055	26048	76885	52 30	01911	28192	85109
23 00	04012	26091	77032	53 00	01882	28221	85236
23 30	03969	26134	77179	53 30	01854	28249	85363
24 00	03927	26177	77325	54 00	01826	28277	85490
24 30	03885	26218	77471	54 30	01798	28305	85617
25 00	03843	26260	77616	55 00	01770	28333	85744
25 30	0.03801	5.26302	4.77661	55 30	0.01743	5.28360	4.85870
26 00	03760	26343	77906	56 00	01716	28387	85996
26 30	03719	26384	78050	56 30	01689	28414	86121
27 00	03678	26425	78194	57 00	01662	28441	86246
27 30	03638	26466	78338	57 30	01635	28468	86371
28 00	03597	26506	78481	58 00	01609	28494	86496
28 30	03557	26546	78624	58 30	01583	28520	86621
29 00	03517	26586	78767	59 00	01557	28546	86745
29 30	03478	26626	78909	59 30	01531	28572	86869
30 00	03438	26665	79051	60 00	01505	28598	86993

LATITUDE by Two Altitudes. 5 HOURS.

M.S.	Elapl. Time.	Middle Time.	Rising.	M.S.	Elapl. Time.	Middle Time.	Rising.
00 30	0.01480	5.28623	4.87116	30 30	0.00361	5.29742	4.94033
01 00	01455	28648	87239	31 00	00349	29754	94141
01 30	01430	28673	87362	31 30	00337	29766	94248
02 00	01405	28698	87484	32 00	00325	29778	94356
02 30	01381	28722	87606	32 30	00313	29790	94463
03 00	01357	28746	87728	33 00	00301	29801	94570
03 30	01333	28770	87850	33 30	00291	29812	94676
04 00	01309	28794	87971	34 00	00280	29823	94782
04 30	01286	28817	88092	34 30	00269	29834	94888
05 00	01263	28840	88213	35 00	00259	29844	94994
05 30	0.01240	5.28863	4.88334	35 30	0.00249	5.29854	5.95100
06 00	01217	28886	88454	36 00	00239	29864	95205
06 30	01194	28909	88574	36 30	00229	29874	95310
07 00	01172	28931	88694	37 00	00219	29884	95415
07 30	01150	28953	88814	37 30	00209	29894	95520
08 00	01128	28975	88933	38 00	00200	29903	95624
08 30	01106	28997	89052	38 30	00191	29912	95728
09 00	01084	29019	89171	39 00	00182	29911	95832
09 30	01063	29040	89289	39 30	00174	29929	95936
10 00	01042	29061	89407	40 00	00166	29937	96040
10 30	0.01021	5.29082	4.89525	40 30	0.00157	5.29945	5.96143
11 00	01000	29103	89643	41 00	00150	29953	96246
11 30	00980	29123	89760	41 30	00142	29961	96349
12 00	00960	29143	89877	42 00	00134	29969	96452
12 30	00940	29163	89994	42 30	00127	29976	96554
13 00	00928	29183	90111	43 00	00120	29983	96656
13 30	00900	29203	90227	43 30	00113	29990	96758
14 00	00881	29222	90343	44 00	00106	29997	96860
14 30	00862	29241	90459	44 30	00099	30004	96961
15 00	00843	29260	90575	45 00	00093	30010	97062
15 30	0.00824	5.29279	4.90690	45 30	0.00087	5.30016	4.97163
16 00	00805	29298	90805	46 00	00081	30022	97264
16 30	00787	29316	90920	46 30	00075	30028	97365
17 00	00769	29334	91035	47 00	00070	30033	97465
17 30	00751	29352	91149	47 30	00065	30038	97565
18 00	00733	29370	91263	48 00	00060	30043	97665
18 30	00716	29387	91377	48 30	00055	30048	97765
19 00	00699	29404	91490	49 00	00050	30053	97865
19 30	00682	29421	91603	49 30	00045	30058	97964
20 00	00665	29438	91716	50 00	00041	30062	98063
20 30	0.00648	5.29455	4.91829	50 30	0.00037	5.30066	5.98162
21 00	00632	29471	91942	51 00	00033	30070	98261
21 30	00616	29487	92054	51 30	00029	30074	98359
22 00	00600	29503	92166	52 00	00026	30077	98457
22 30	00584	29519	92278	52 30	00023	30080	98555
23 00	00568	29535	92390	53 00	00020	30083	98653
23 30	00553	29550	92501	53 30	00017	30086	98751
24 00	00538	29565	92612	54 00	00015	30088	98848
24 30	00523	29580	92723	54 30	00012	30090	98945
25 00	00508	29595	92834	55 00	00010	30092	99042
25 30	0.00494	5.29609	4.92944	55 30	0.00005	5.30094	5.99139
26 00	00480	29623	93054	56 00	00007	30096	99236
26 30	00466	29637	93164	56 30	00005	30098	99332
27 00	00452	29651	93274	57 00	00004	30099	99428
27 30	00438	29665	93383	57 30	00003	30100	99524
28 00	00425	29678	93492	58 00	00002	30101	99620
28 30	00412	29691	93601	58 30	00001	30102	99715
29 00	00399	29704	93709	59 00	00000	30103	99810
29 30	00386	29717	93817	59 30	00000	30103	99905
30 00	00373	29730	93925	60 00	00000	30103	5.00000

A Table of Natural Sines.

0		1		2		3		4			
M.	N. fine	N. Col.	N. fine	N. Col.	N. fine	N. Col.	N. fine	N. Col.	N. fine	N. Col.	M.
0	00	100000	1745	99985	2490	99939	5234	99863	6976	99756	60
1	29	0000	1774	984	3519	938	5263	861	7005	754	59
2	58	0000	1803	984	3548	937	5292	860	7034	752	58
3	87	0000	1832	983	3577	936	5321	858	7063	750	57
4	116	0000	1862	983	3606	935	5350	857	7092	748	56
5	145	0000	1891	982	3635	934	5379	855	7121	746	55
6	175	0000	1920	982	3664	933	5408	854	7150	744	54
7	204	10000	1949	99981	3693	99932	5437	99852	7179	99742	53
8	233	0000	1978	980	3723	931	5466	851	7208	740	52
9	262	0000	2007	980	3752	930	5495	849	7237	738	51
10	291	0000	2036	979	3781	929	5524	847	7266	736	50
11	323	99999	2065	979	3810	927	5553	846	7295	734	49
12	349	999	2094	978	3839	926	5582	844	7324	731	48
13	378	99999	2123	99977	3868	99925	5611	99842	7353	99729	47
14	407	999	2152	977	3897	924	5640	841	7382	728	46
15	436	999	2181	976	3926	923	5669	839	7411	725	45
16	465	999	2211	976	3955	922	5698	838	7440	723	44
17	495	999	2240	975	3984	921	5727	836	7469	721	43
18	524	999	2269	974	4013	919	5756	834	7498	719	42
19	553	99998	2298	99974	4042	99918	5785	99833	7527	99716	41
20	582	998	2327	973	4071	917	5814	831	7556	714	40
21	611	998	2356	972	4100	916	5844	829	7585	712	39
22	640	998	2385	972	4129	915	5873	827	7614	710	38
23	669	998	2414	971	4159	914	5902	826	7643	708	37
24	698	998	2443	970	4188	912	5931	824	7672	705	36
25	727	99997	2472	99969	4217	99911	5960	99822	7701	99703	35
26	756	997	2501	969	4246	910	5989	821	7730	701	34
27	785	997	2530	968	4275	909	6018	819	7759	699	33
28	814	997	2560	967	4304	907	6047	817	7788	696	32
29	844	996	2589	966	4333	906	6076	815	7817	694	31
30	873	996	2618	966	4362	905	6105	813	7846	692	30
31	902	99996	2647	99965	4391	99904	6134	99812	7875	99689	29
32	931	996	2676	964	4420	902	6163	810	7904	687	28
33	960	995	2705	963	4449	901	6192	808	7933	685	27
34	989	995	2734	963	4478	900	6221	806	7962	683	26
35	1018	995	2763	962	4507	898	6250	804	7991	680	25
36	1047	995	2792	961	4536	897	6279	803	8020	678	24
37	1076	99994	2821	99960	4565	99890	6308	99801	8049	99676	23
38	1105	994	2850	959	4594	894	6337	799	8078	673	22
39	1134	994	2879	959	4623	893	6366	797	8107	671	21
40	1164	993	2908	958	4653	892	6395	795	8136	668	20
41	1193	993	2938	957	4682	890	6424	793	8165	666	19
42	1222	993	2967	956	4711	889	6453	792	8194	664	18
43	1251	99992	2996	99955	4740	99888	6482	99790	8223	99661	17
44	1280	992	3025	954	4769	886	6511	788	8252	659	16
45	1309	991	3054	953	4798	885	6540	786	8281	657	15
46	1338	991	3083	952	4827	883	6569	784	8310	654	14
47	1367	991	3112	952	4856	882	6590	782	8339	652	13
48	1396	990	3141	951	4885	881	6627	780	8368	649	12
49	1425	99990	3170	99950	4914	99879	6656	99778	8397	99647	11
50	1454	989	3199	949	4943	878	6685	776	8426	644	10
51	1483	989	3228	948	4972	876	6714	774	8455	642	9
52	1513	989	3257	947	5001	875	6743	772	8484	639	8
53	1542	988	3286	946	5030	873	6773	770	8513	637	7
54	1571	988	3316	945	5059	872	6802	768	8542	635	6
55	1600	99987	3345	99944	5088	99870	6835	99766	8571	99632	5
56	1629	987	3374	943	5117	869	6860	764	8600	630	4
57	1658	986	3403	942	5146	867	6889	762	8629	627	3
58	1687	986	3432	941	5175	866	6918	760	8658	625	2
59	1716	985	3461	940	5205	864	6947	758	8687	632	1
N. Col. N. fine N. Col. N. fine N. Col. N. fine N. Col. N. fine N. Col. N. fine											
89 88 87 86 85											

A Table of Natural Sines.

	5		6		7		8		9		
M.	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	M.
0	8716	99019	10453	99452	12187	99255	13917	99027	15643	98769	60
1	8745	617	482	449	216	251	946	023	672	764	59
2	8774	614	511	446	245	248	975	019	701	760	58
3	8803	612	540	443	274	244	14004	015	730	755	57
4	8831	609	569	440	302	240	033	011	758	751	56
5	8860	607	597	437	331	237	061	006	787	746	55
6	8889	604	626	434	360	233	090	002	816	741	54
7	8918	99602	10655	99431	12389	99230	14119	98998	15845	98737	53
8	8947	599	684	428	418	226	148	994	873	732	52
9	8976	596	713	424	447	222	177	990	902	728	51
10	9005	594	742	421	476	219	205	986	931	723	50
11	9034	591	771	418	504	215	234	982	959	718	49
12	9063	588	800	415	533	211	263	978	988	714	48
13	9092	99586	10829	99412	12562	99208	14292	98973	16017	98709	47
14	9121	583	858	409	601	204	320	969	046	704	46
15	9150	580	887	406	620	200	349	965	074	700	45
16	9179	578	916	402	649	197	378	961	103	695	44
17	9208	575	945	399	678	193	407	957	132	690	43
18	9237	572	973	396	706	189	436	953	160	686	42
19	9266	99570	11002	99393	12735	99186	14464	98948	16189	98681	41
20	9295	567	031	390	764	182	493	944	218	676	40
21	9324	564	060	386	793	178	522	940	246	671	39
22	9353	562	089	383	822	175	551	936	275	667	38
23	9382	559	118	380	851	171	580	931	304	662	37
24	9411	556	147	377	880	167	608	927	333	657	36
25	9440	99553	11176	99374	12908	99163	14637	98923	16361	98652	35
26	9469	551	205	370	937	160	66	919	390	648	34
27	9498	548	234	367	966	156	695	914	419	643	33
28	9527	545	263	364	995	152	723	910	447	638	32
29	9556	542	291	360	13024	148	752	906	476	633	31
30	9585	540	320	357	053	144	781	902	505	629	30
31	9614	99537	11349	99354	13081	99141	14810	98897	16533	98624	29
32	9643	534	378	351	110	137	838	893	562	619	28
33	9671	531	407	347	139	133	867	889	591	614	27
34	9700	528	436	344	168	129	896	884	620	609	26
35	9729	526	465	341	197	125	925	880	648	604	25
36	9758	523	494	337	226	122	954	876	677	600	24
37	9787	99520	11523	99334	13254	99118	1492	98871	16706	98595	23
38	9816	517	552	331	283	114	15011	867	734	590	22
39	9845	514	580	327	312	110	040	863	763	585	21
40	9874	511	609	324	341	106	069	858	792	580	20
41	9903	508	638	320	370	102	097	854	820	575	19
42	9932	506	667	317	399	098	126	849	849	570	18
43	9961	99503	11696	99314	13427	99094	15155	98845	16878	98565	17
44	9990	500	725	310	456	091	184	841	906	561	16
45	10019	497	754	307	485	087	212	836	935	556	15
46	10048	494	783	303	514	083	241	832	964	551	14
47	10077	491	812	300	543	079	270	827	992	546	13
48	10106	488	840	297	572	075	299	823	17021	541	12
49	10135	99485	11869	99293	13600	99071	15327	98818	17051	98536	11
50	10164	482	868	290	629	067	356	814	078	531	10
51	10192	479	927	286	658	063	385	809	107	526	9
52	10221	476	956	283	687	059	414	805	136	521	8
53	10250	473	985	279	716	055	442	800	164	516	7
54	10279	470	12014	276	744	051	471	796	193	511	6
55	10308	99467	12043	99272	13773	99047	15500	98791	17222	98506	5
56	10337	464	071	269	802	043	509	787	250	501	4
57	10366	461	100	265	831	039	557	782	279	496	3
58	10395	458	129	262	860	035	586	778	308	491	2
59	10424	455	158	258	889	031	615	773	336	486	1
	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	
	84		83		82		81		80		

S. A.

M m

A Table of Natural Sines.

	10		11		12		13		14		
M.	N.fine	N.Cof	N.fine	N.Cof	N.fine	N.Cof	N.fine	N.Cof	N.fine	N.Cof	M.
0	17365	98481	19081	98163	20791	97815	22495	97437	24192	97030	60
1	393	476	109	157	820	809	523	430	220	023	59
2	422	471	138	152	848	803	552	424	249	015	58
3	451	466	167	146	877	797	580	417	277	008	57
4	479	460	195	140	905	790	608	411	305	001	56
5	508	455	224	135	933	784	637	404	333	96994	55
6	537	450	252	129	962	778	665	398	361	987	54
7	17565	98445	19281	98124	20990	97772	22693	97391	24390	96980	53
8	594	440	309	118	21019	766	722	384	418	973	52
9	623	435	338	112	047	760	750	378	446	966	51
10	651	430	366	107	076	754	778	371	474	959	50
11	680	425	395	101	104	748	807	365	503	952	49
12	708	420	42	096	132	742	835	358	531	945	48
13	17737	98414	19452	98090	21161	97735	22863	97351	24559	96937	47
14	766	409	450	084	189	729	892	345	587	930	46
15	794	404	509	079	218	723	920	338	615	923	45
16	823	399	538	073	246	717	948	331	644	916	44
17	852	394	566	067	275	711	977	325	672	909	43
18	880	389	595	061	303	705	23005	318	700	902	42
19	17909	98383	19623	98056	21331	97698	23033	97311	24728	96894	41
20	937	378	652	050	360	692	062	304	756	887	40
21	966	373	680	044	388	686	090	298	784	880	39
22	995	368	709	039	417	680	118	291	813	873	38
23	18023	362	737	033	445	673	146	284	841	866	37
24	052	357	766	027	474	667	175	278	869	858	36
25	18081	98352	19794	98021	21502	97661	23203	97271	24897	96851	35
26	109	347	823	016	530	655	231	264	925	844	34
27	138	341	851	010	559	648	260	257	953	837	33
28	166	336	880	004	587	642	288	251	982	829	32
29	195	331	908	97998	616	636	316	244	25010	822	31
30	224	325	937	992	644	630	345	237	038	815	30
31	18252	98320	19965	97987	21672	97623	23373	97230	25066	96807	29
32	281	315	994	981	701	617	401	223	094	800	28
33	309	310	20022	975	729	611	429	217	122	793	27
34	338	304	051	969	758	604	458	210	151	786	26
35	367	299	079	963	786	598	486	203	179	778	25
36	395	294	108	958	814	592	514	196	207	771	24
37	18424	98288	20130	97952	21843	97585	23542	97189	25235	96764	23
38	452	283	165	946	871	579	571	182	263	756	22
39	481	277	193	940	899	573	599	176	291	749	21
40	509	272	222	934	928	566	627	169	320	742	20
41	538	267	250	928	956	560	656	162	348	734	19
42	567	261	279	922	985	553	684	155	376	727	18
43	18595	98256	20307	97916	22013	97547	23712	97148	25404	96719	17
44	624	250	336	910	041	541	740	141	432	712	16
45	652	245	364	905	070	534	769	134	460	705	15
46	681	240	393	899	098	528	797	127	488	697	14
47	710	234	421	893	126	521	825	120	516	690	13
48	738	229	450	887	155	515	853	113	545	682	12
49	18767	98223	20478	97881	22185	97508	23882	97106	25573	96675	11
50	795	218	507	875	212	502	910	100	601	667	10
51	824	212	535	869	240	496	938	093	629	660	9
52	852	207	563	863	268	489	966	086	657	653	8
53	881	201	592	857	297	483	995	079	685	645	7
54	910	196	620	851	325	476	24023	072	713	638	6
55	18938	98190	20649	97845	22353	97470	24051	97065	25741	96630	5
56	967	185	677	839	382	463	079	058	769	623	4
57	995	179	706	833	410	457	108	051	798	615	3
58	19024	174	734	827	438	450	136	044	826	608	2
59	052	168	763	821	467	444	164	037	854	600	1
	N.Cof	N.fine	N.Cof	N.fine	N.Cof	N.fine	N.Cof	N.fine	N.Cof	N.fine	
	79		78		77		76		75		

A Table of Natural Sines.

	15		16		17		18		19		
M.	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	M.
0	25882	96593	27564	96126	29237	95630	30902	95106	32557	94552	60
1	910	585	592	118	265	622	929	097	584	542	59
2	938	578	620	110	293	613	957	088	612	533	58
3	966	570	648	102	321	605	985	079	639	523	57
4	994	562	676	094	348	596	31012	070	667	514	56
5	26022	555	704	086	376	588	040	061	694	504	55
6	050	547	731	078	404	579	068	052	722	495	54
7	26079	96540	27759	96070	29432	95571	31095	95043	32749	94485	53
8	107	532	787	062	460	562	123	033	777	476	52
9	135	524	815	054	487	554	151	024	804	466	51
10	163	517	843	046	515	545	178	015	832	457	50
11	191	509	871	037	543	536	206	006	859	447	49
12	219	502	899	029	571	528	233	94997	887	438	48
13	26247	96494	27927	96021	29599	95519	31261	94988	32914	94428	47
14	275	486	955	013	626	511	289	979	942	418	46
15	303	479	983	005	654	502	316	970	969	409	45
16	331	471	28011	95997	682	493	344	961	997	399	44
17	359	463	039	989	710	485	372	952	33024	390	43
18	587	456	067	981	737	476	399	943	051	380	42
19	26415	96448	28095	95972	29765	95467	31427	94933	33079	94370	41
20	443	440	123	964	793	459	454	924	106	361	40
21	471	433	150	956	821	450	482	915	134	351	39
22	500	425	178	948	849	441	510	906	161	342	38
23	528	417	206	940	876	433	537	897	189	332	37
24	556	410	234	931	904	424	565	888	216	322	36
25	26584	96402	28262	95923	29932	95415	31593	94878	33244	94313	35
26	612	394	290	915	960	407	620	869	271	303	34
27	640	386	318	907	987	398	648	860	298	293	33
28	668	379	346	898	30015	389	675	851	326	284	32
29	696	371	374	890	043	380	703	842	353	274	31
30	724	363	402	882	071	372	730	832	381	264	30
31	26752	96355	28429	95874	30093	95363	31758	94823	33402	94254	29
32	780	347	457	865	126	354	786	814	436	245	28
33	808	340	485	857	154	345	813	805	463	235	27
34	836	332	513	849	182	337	841	795	490	225	26
35	864	324	541	841	209	328	868	786	518	216	25
36	892	316	569	832	237	319	869	777	545	206	24
37	26920	96308	28597	95824	30265	95310	31923	94768	33573	94190	23
38	948	301	625	816	292	301	951	758	600	186	22
39	976	293	652	807	320	293	979	749	627	176	21
40	27004	285	687	799	348	284	32000	740	655	167	20
41	032	277	708	791	376	275	034	730	682	157	19
42	060	269	736	782	403	266	061	721	710	147	18
43	27088	96261	28764	95774	30431	95257	32089	94712	33737	94137	17
44	116	253	792	766	459	248	110	702	764	127	16
45	144	246	820	757	486	240	144	693	792	118	15
46	172	238	847	749	514	231	171	684	819	108	14
47	200	230	875	740	542	222	199	674	846	098	13
48	228	222	903	732	570	213	227	665	874	088	12
49	27256	96214	28931	95724	30597	95204	32254	94656	33901	94078	11
50	284	206	959	715	625	195	282	646	929	068	10
51	312	198	987	707	653	186	309	637	956	058	9
52	340	190	29015	698	680	177	337	627	983	049	8
53	368	182	042	690	708	168	364	618	34011	039	7
54	396	174	070	681	736	159	392	609	038	029	6
55	27424	96106	29095	95673	30763	95150	32419	94599	34065	94019	5
56	452	158	126	664	791	142	447	590	093	009	4
57	480	150	154	656	819	133	474	580	120	93999	3
58	508	142	182	647	846	124	502	571	147	989	2
59	536	134	209	639	874	115	529	561	175	979	1
N. Col		N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	N. Col	N. line	
74			73		72		71		70		

A Table of Natural Sines:

20			21		22		23		24		
M.	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	M.
0	3420	93969	35837	93358	37461	92718	39073	92050	40674	91355	00
1	229	959	864	348	488	707	100	030	700	343	59
2	257	949	891	337	515	697	127	028	727	331	58
3	284	939	918	327	542	686	153	016	753	319	57
4	311	929	945	316	569	675	180	005	780	307	56
5	339	919	973	306	595	664	207	91994	806	295	55
6	360	909	36000	295	622	653	234	982	833	283	54
7	34393	93899	36027	93285	37049	92642	39260	91971	40800	91272	53
8	421	889	054	274	676	631	287	959	880	260	52
9	448	879	081	264	703	620	314	948	913	248	51
10	475	869	108	253	730	609	341	936	939	236	50
11	503	859	135	243	757	598	367	925	966	224	49
12	530	849	162	232	784	587	394	914	992	212	48
13	34557	93839	36190	93222	37811	92576	39421	91902	41019	9120	47
14	504	829	217	211	838	565	448	891	045	188	46
15	612	819	244	201	865	554	474	879	072	176	45
16	639	809	271	190	892	543	501	868	098	164	44
17	666	799	298	180	919	532	528	856	125	152	43
18	694	789	325	169	946	521	555	805	151	140	42
19	34721	93779	36352	93159	37973	92510	39581	91833	41178	91128	41
20	748	769	379	148	999	499	608	822	204	116	40
21	775	759	406	137	38026	488	635	810	231	104	39
22	803	748	433	127	053	477	661	799	257	092	38
23	830	738	461	116	080	466	688	787	284	080	37
24	857	728	488	106	107	455	715	775	310	068	36
25	34884	93718	36515	93095	38134	92444	39741	91764	41337	91056	35
26	912	708	542	084	161	422	768	752	363	044	34
27	939	698	569	073	188	421	795	741	390	032	33
28	960	688	596	063	215	410	822	729	416	020	32
29	993	677	623	052	241	399	848	718	443	008	31
30	35021	667	650	042	268	388	875	706	469	90956	30
31	35048	93657	36677	93031	38295	92377	39902	91694	41496	90984	29
32	075	647	704	020	322	366	928	685	522	972	28
33	102	637	731	010	349	355	955	671	549	960	27
34	130	626	758	92999	376	343	982	660	575	948	26
35	157	616	785	988	403	332	40008	648	602	936	25
36	184	606	812	978	430	321	035	636	628	924	24
37	35211	93596	36839	92967	38456	92310	40062	91625	41655	90911	23
38	239	585	807	956	483	299	088	613	681	899	22
39	260	575	894	945	510	287	115	601	707	887	21
40	293	565	921	935	537	276	141	590	734	875	20
41	320	555	948	924	564	265	168	578	760	863	19
42	347	544	975	913	591	254	195	566	787	851	18
43	35375	93534	37002	92902	38617	92243	40221	91555	41813	90839	17
44	402	524	029	892	644	231	248	543	840	826	16
45	429	514	056	881	671	220	275	531	866	814	15
46	456	503	083	870	698	209	301	519	892	802	14
47	483	493	110	859	725	198	328	508	919	790	13
48	511	483	137	849	752	186	355	496	945	778	12
49	35538	93472	37164	92838	38778	92175	40381	91484	41972	90766	11
50	565	462	191	827	805	164	408	472	998	753	10
51	592	452	218	816	832	152	434	461	42024	741	9
52	619	441	245	805	859	141	461	449	051	729	8
53	647	431	272	794	886	130	488	437	077	717	7
54	674	420	299	783	912	119	514	425	104	704	6
55	35701	93410	37326	92773	38939	92107	40541	91414	42130	90692	5
56	728	400	353	762	966	096	567	402	156	680	4
57	755	389	380	751	993	085	594	390	183	668	3
58	782	379	407	740	39020	073	621	378	209	655	2
59	810	368	434	729	046	062	647	366	235	643	1
[N. of N. fine N. Col N. fine N. Col N. fine N. Col N. fine N. Col N. fine N. Col]											
69 68 67 66 65											

A Table of Natural Sines.

[illegible]

A Table of Natural Sines.

30		31		32		33		34			
M.	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	M.
0	50000	86603	51504	85717	52992	84805	54464	83867	55919	82904	60
1	025	588	529	702	53017	789	488	851	943	887	59
2	050	573	554	687	041	774	513	835	968	871	58
3	076	559	579	672	066	759	537	819	992	855	57
4	101	544	604	657	091	743	561	804	56016	839	56
5	126	530	628	642	115	728	586	788	040	822	55
6	151	515	653	627	140	712	610	772	064	806	54
7	50176	86501	51678	85612	53164	84097	54635	83756	56288	82790	53
8	201	486	703	597	189	081	659	740	112	773	52
9	227	471	728	532	214	666	683	724	136	757	51
10	252	457	753	567	238	650	708	708	160	741	50
11	277	442	778	551	263	635	732	692	184	724	49
12	302	427	803	536	288	619	756	676	208	708	48
13	50327	86413	51828	85521	53312	84604	54781	83660	56232	82692	47
14	352	398	852	506	337	588	805	645	256	675	46
15	377	384	877	491	361	573	829	629	280	659	45
16	403	369	902	476	386	557	854	613	305	643	44
17	428	354	927	461	411	542	878	597	329	626	43
18	453	340	952	446	435	526	902	581	353	610	42
19	50478	86325	51977	85431	53460	84511	54926	83565	56377	82593	41
20	503	310	52002	416	484	495	951	549	401	577	40
21	528	295	026	401	509	480	975	533	425	561	39
22	553	281	051	385	534	464	999	517	449	544	38
23	578	266	076	370	558	448	55024	501	473	528	37
24	603	251	101	355	583	433	048	485	497	511	36
25	50628	86237	52126	85340	53607	84417	55072	83469	56521	82445	35
26	654	222	151	325	632	402	097	453	545	478	34
27	679	207	175	310	656	386	121	437	569	462	33
28	704	192	200	294	681	370	145	421	593	446	32
29	729	178	225	279	705	355	169	405	617	429	31
30	754	163	250	264	730	339	194	389	641	413	30
31	50779	86148	52275	85249	53754	84324	55218	83373	56665	82396	29
32	804	133	299	234	779	308	242	356	689	380	28
33	829	119	324	218	804	292	266	340	713	363	27
34	854	104	349	203	828	277	291	324	736	347	26
35	879	089	374	188	853	261	315	308	760	330	25
36	904	074	398	173	877	245	339	292	784	314	24
37	50929	86059	52423	85157	53902	84230	55303	83276	56808	82297	23
38	954	045	448	142	926	214	383	260	832	281	22
39	979	030	473	127	951	198	412	244	856	264	21
40	51004	015	498	112	975	182	436	228	880	248	20
41	029	000	522	096	54000	167	460	212	904	231	19
42	054	85985	547	081	024	151	484	195	928	214	18
43	51079	85970	52572	85066	54049	84135	55509	83179	56952	82198	17
44	104	956	597	051	073	120	533	163	976	181	16
45	129	941	621	035	097	104	557	147	57000	165	15
46	154	926	646	020	122	088	581	131	024	148	14
47	179	911	671	005	146	072	605	115	047	132	13
48	204	896	696	84989	171	057	630	098	071	115	12
49	51229	85881	52720	84974	54195	84041	55654	83082	57095	82098	11
50	254	866	745	959	220	025	678	066	119	082	10
51	279	851	770	943	244	009	702	050	143	065	9
52	304	836	794	928	269	83994	726	034	167	048	8
53	329	821	819	913	293	978	750	017	191	031	7
54	354	806	844	897	317	902	775	001	215	015	6
55	379	85792	52869	84882	54342	83946	55799	82985	57238	81999	5
56	404	777	893	866	366	930	823	964	262	982	4
57	429	762	918	851	391	915	847	953	286	965	3
58	454	747	943	836	415	899	871	936	310	949	2
59	479	732	967	820	439	883	895	920	334	932	1
[N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine] [N. of N. fine]											
59 58 57 56 55											

A Table of Natural Sines.

	35		36		37		38		39		
N.	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	M.
0	57358	81915	58779	80902	60181	79864	61566	78801	62932	77715	60
1	381	899	802	885	205	846	589	783	955	696	59
2	405	882	826	867	228	829	612	765	977	678	58
3	429	865	849	850	251	811	635	747	63000	660	57
4	453	848	873	833	274	793	658	729	022	641	56
5	477	832	896	816	298	776	681	711	045	623	55
6	501	815	920	799	321	758	704	693	068	605	54
7	57524	81798	58943	80782	60344	79741	61726	78676	63090	77586	53
8	548	781	967	765	367	723	749	658	113	568	52
9	572	765	990	748	390	706	772	640	135	550	51
10	596	748	59014	730	414	688	795	622	158	531	50
11	619	731	037	713	437	671	818	604	180	513	49
12	643	714	061	696	460	653	841	586	203	494	48
13	57667	81698	59084	80679	60483	79635	61864	78568	63225	77476	47
14	691	681	107	662	506	618	887	550	248	458	46
15	715	664	131	644	529	600	909	532	271	439	45
16	738	647	154	627	553	583	932	514	293	421	44
17	762	631	178	610	576	565	955	496	316	402	43
18	786	614	201	593	599	547	978	478	338	384	42
19	57809	81597	59225	80576	60622	79530	62001	78460	63361	77366	41
20	833	580	248	558	645	512	024	442	383	347	40
21	857	563	272	541	668	494	046	424	406	329	39
22	881	546	295	524	691	477	069	405	428	310	38
23	904	530	318	507	714	459	092	387	451	292	37
24	929	513	342	489	738	441	115	369	473	273	36
25	57952	81496	59365	80472	60761	79424	62138	78351	63496	77255	35
26	976	479	389	455	784	406	160	333	518	236	34
27	999	462	412	438	807	388	183	315	540	218	33
28	8023	445	435	420	830	371	206	297	563	199	32
29	047	428	459	403	853	353	229	279	585	181	31
30	070	412	482	386	876	335	251	261	608	162	30
31	58094	81395	59506	80368	60899	79318	62274	78245	63630	77144	29
32	118	378	529	351	922	300	297	225	653	125	28
33	141	361	552	334	945	282	320	206	675	107	27
34	165	344	576	316	968	264	342	188	698	088	26
35	189	327	599	299	991	247	365	170	720	070	25
36	212	310	622	282	61015	229	388	152	742	051	24
37	58236	81293	59046	80264	61038	79211	62411	78134	63765	77033	23
38	260	270	669	247	061	193	433	116	787	014	22
39	283	259	693	230	084	176	456	098	810	76996	21
40	307	242	716	212	107	158	479	079	832	977	20
41	330	225	739	195	130	140	502	061	854	959	19
42	354	208	763	178	153	122	524	043	877	940	18
43	58378	81191	59786	80160	61176	79105	62547	78025	63899	76921	17
44	401	174	809	143	199	087	570	007	922	903	16
45	425	157	832	125	222	069	592	77988	944	884	15
46	449	140	856	108	245	051	615	970	966	866	14
47	472	123	879	091	268	033	638	952	989	847	13
48	496	106	902	073	291	015	660	934	64011	828	12
49	58519	81089	59926	80056	61314	78998	62683	77916	64033	76810	11
50	543	072	949	038	337	980	706	897	056	791	10
51	567	055	972	021	360	962	728	879	078	772	9
52	590	038	995	003	383	944	751	861	100	754	8
53	614	021	60019	79986	406	926	774	843	123	735	7
54	637	004	042	968	429	908	796	824	145	717	6
55	58661	80987	60065	79951	61451	78891	62819	77806	64167	76698	5
56	684	970	089	934	474	873	842	788	190	679	4
57	708	953	112	916	497	855	864	769	212	661	3
58	731	936	135	899	520	837	887	751	234	642	2
59	755	919	158	881	543	819	909	733	256	623	1
N. Col		N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	N. Col	N. fine	
54			53		52		51		50		

A Table of Natural Sines.

40		41		42		43		44							
N.	line	N.	Col	N.	line	N.	Col	N.	line	N.	Col	N.	line	N.	Col
0	64279	76004	65606	75471	66913	77314	68200	73135	69466	71934	60				
1	301	586	628	452	935	295	221	116	487	914	59				
2	323	567	650	433	956	276	242	096	508	894	58				
3	346	548	672	414	978	256	264	076	529	873	57				
4	368	530	694	395	999	237	285	056	549	853	56				
5	390	511	715	375	67021	217	300	036	570	833	55				
6	412	492	738	356	045	198	327	016	592	813	54				
7	64435	76473	65759	75337	67004	74178	68349	72999	69612	71792	53				
8	457	455	781	318	080	159	370	976	633	772	52				
9	479	436	803	299	107	139	391	957	654	752	51				
10	501	417	825	280	129	120	412	937	675	732	50				
11	524	398	847	261	151	100	433	917	696	711	49				
12	546	380	869	241	172	080	455	897	717	691	48				
13	64562	70361	65891	75222	67194	74061	68476	72877	69737	71671	47				
14	590	342	913	203	215	041	497	857	758	650	46				
15	612	323	935	184	237	022	518	837	779	630	45				
16	635	304	956	165	258	002	539	817	800	610	44				
17	657	286	978	146	280	73983	561	797	821	590	43				
18	679	267	66000	120	301	963	582	777	842	569	42				
19	64701	76248	66022	75107	67323	73944	68603	72757	69862	71549	41				
20	723	229	044	088	344	924	624	737	883	529	40				
21	746	210	066	069	366	904	645	717	904	508	39				
22	768	192	088	050	387	885	666	697	925	488	38				
23	790	173	109	030	409	865	688	677	946	468	37				
24	812	154	131	011	430	847	709	657	966	447	36				
25	64834	76135	66153	74992	67452	73826	68730	72637	69987	71427	35				
26	851	116	175	973	473	806	751	617	70008	407	34				
27	878	097	197	953	495	787	772	597	029	386	33				
28	904	078	218	934	516	767	793	577	049	366	32				
29	923	059	240	915	538	747	814	557	070	345	31				
30	945	041	262	896	559	728	835	537	091	325	30				
31	64967	76022	66284	74876	67580	73708	68857	72517	70112	71305	29				
32	989	003	306	857	602	688	878	497	132	284	28				
33	65011	75984	327	838	623	669	899	477	153	264	27				
34	033	965	349	818	645	640	920	457	174	243	26				
35	055	946	371	799	666	629	941	437	195	223	25				
36	077	927	393	780	688	610	962	417	215	203	24				
37	65099	75908	66414	74760	67709	73590	68983	72397	70236	71182	23				
38	122	889	436	741	730	570	69004	377	257	162	22				
39	144	870	458	722	752	551	075	357	277	141	21				
40	166	851	480	703	775	531	046	337	298	121	20				
41	188	832	501	683	795	511	067	317	319	100	39				
42	210	813	523	664	816	491	088	297	339	080	18				
43	65232	75794	66545	74644	67837	73472	69109	72777	70360	71059	17				
44	254	775	500	625	859	452	130	257	381	039	16				
45	276	756	588	606	880	432	151	236	401	019	15				
46	298	738	610	586	901	412	172	216	422	70998	14				
47	320	719	632	567	923	393	193	196	443	978	13				
48	342	699	653	548	944	373	214	176	463	957	12				
49	64364	75680	66675	74528	67963	73353	69235	72156	70484	70937	11				
50	386	661	697	509	987	333	256	136	505	610	10				
51	408	642	718	489	68008	314	277	116	525	896	9				
52	430	623	740	470	029	294	298	095	546	875	8				
53	452	604	762	451	051	275	319	075	567	855	7				
54	474	585	783	431	072	254	340	055	587	834	6				
55	65496	75566	66805	74412	68093	73234	69361	72035	70600	70713	5				
56	518	547	827	392	115	215	382	015	628	793	4				
57	540	528	848	373	136	195	403	71995	649	772	3				
58	562	509	870	353	157	175	424	974	670	752	2				
59	583	490	892	334	179	155	445	954	691	731	1				
N. Col		N. line		N. Col		N. line		N. Col		N. line		N. Col		N. line	
49		48		47		46		45							

Of Logarithmic Sines, Tangents, and Secants, to every Point and Quarter Point of the Compass.

Points.	Sines.	Co-sines.	Tangent.	Co-tang.	Secants.	Co-secan.	Points.
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	8
0 $\frac{1}{4}$	8.69079	9.99947	8.69131	11.30867	10.00053	11.30921	7 $\frac{3}{4}$
0 $\frac{1}{2}$	8.99130	9.99790	8.99340	11.00660	10.00210	11.00870	7 $\frac{1}{2}$
0 $\frac{3}{4}$	9.16652	9.99527	9.17124	10.82875	10.00473	10.83348	7 $\frac{1}{4}$
1	9.29024	9.99157	9.29866	10.70134	10.00843	10.70976	7
1 $\frac{1}{4}$	9.38557	9.98679	9.39878	10.60121	10.01321	10.61443	6 $\frac{3}{4}$
1 $\frac{1}{2}$	9.46282	9.98088	9.48194	10.51806	10.01912	10.53717	6 $\frac{1}{2}$
1 $\frac{3}{4}$	9.52749	9.97385	9.55365	10.44639	10.02616	10.47251	6 $\frac{1}{4}$
2	9.58284	9.96562	9.61722	10.38278	10.03438	10.41710	6
2 $\frac{1}{4}$	9.63099	9.95616	9.67482	10.32518	10.04384	10.36901	5 $\frac{3}{4}$
2 $\frac{1}{2}$	9.67339	9.94543	9.72796	10.27204	10.05457	10.32661	5 $\frac{1}{2}$
2 $\frac{3}{4}$	9.71104	9.93335	9.77770	10.22230	10.06665	10.28898	5 $\frac{1}{4}$
3	9.74474	9.91985	9.82489	10.17511	10.08015	10.25526	5
3 $\frac{1}{4}$	9.77503	9.90483	9.87020	10.12980	10.09517	10.22497	4 $\frac{3}{4}$
3 $\frac{1}{2}$	9.80236	9.88819	9.91417	10.08583	10.11181	10.19764	4 $\frac{1}{2}$
3 $\frac{3}{4}$	9.82708	9.86979	9.95729	10.04270	10.13021	10.17292	4 $\frac{1}{4}$
4	9.84948	9.84948	10.00000	10.00000	10.15052	10.15052	4
	Co-sines.	Sines.	Co-tang.	Tangents	Co-secant	Secants.	

A Table of Logarithms from 1 to 100.

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.00000	21	1.32222	41	1.61278	61	1.78533	81	1.90848	101	2.00432
2	0.30103	22	34242	42	62325	62	79239	82	91381	102	00860
3	0.47712	23	36173	43	63347	63	79934	83	91908	103	01284
4	0.60206	24	38021	44	64345	64	80618	84	92428	104	01703
5	0.69897	25	39794	45	65321	65	81291	85	92942	105	02119
6	0.77815	26	41497	46	66276	66	81954	86	93450	106	02531
7	0.84510	27	43136	47	67210	67	82607	87	93952	107	02938
8	0.90309	28	44716	48	68124	68	83251	88	94448	108	03342
9	0.95424	29	46240	49	69020	69	83885	89	94939	109	03743
10	1.00000	30	47712	50	69897	70	84510	90	95424	110	04140
11	1.04139	31	1.49136	51	1.70757	71	1.85126	91	1.95904	111	1.04532
12	0.7918	32	50515	52	71600	72	85733	92	96379	112	04922
13	1.1394	33	51851	53	72428	73	86332	93	96848	113	05308
14	1.4613	34	53148	54	73239	74	86923	94	97313	114	05690
15	1.7609	35	54407	55	74036	75	87506	95	97772	115	06070
16	2.0412	36	55630	56	74819	76	88081	96	98227	116	06446
17	2.3045	37	56820	57	75587	77	88649	97	98677	117	06819
18	2.5527	38	57978	58	76343	78	89209	98	99123	118	07188
19	2.7875	39	59106	59	77085	79	89763	99	99563	119	07555
20	3.0103	40	60206	60	77815	80	90305	100	2.00000	120	07918

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
100	2.00000	2.00433	2.00867	2.01300	2.01733	2.02167	2.02601	2.03034	2.03468	2.03901
101	00432	00475	00518	00561	00604	00647	00689	00732	00775	00817
102	00860	00903	00945	00988	01030	01072	01115	01157	01199	01242
103	01284	01326	01368	01410	01452	01494	01536	01578	01620	01662
104	01703	01745	01787	01828	01870	01912	01953	01995	02036	02077
105	02119	02160	02202	02243	02284	02325	02366	02407	02449	02490
106	02531	02571	02612	02653	02694	02735	02776	02816	02857	02898
107	02938	02979	03019	03060	03100	03141	03181	03222	03262	03302
108	03342	03383	03423	03463	03503	03543	03583	03623	03663	03703
109	03743	03782	03822	03862	03902	03941	03981	04021	04060	04100
110	2.04139	2.04179	2.04218	2.04257	2.04297	2.04336	2.04375	2.04415	2.04454	2.04493
111	04532	04571	04610	04649	04688	04727	04766	04805	04844	04883
112	04922	04961	04999	05038	05077	05115	05154	05192	05231	05269
113	05308	05346	05385	05423	05461	05500	05538	05576	05614	05652
114	0569	05729	05767	05805	05843	05880	05918	05956	05994	06032
115	06070	06108	06145	06183	06221	06258	06296	06333	06371	06408
116	06446	06483	06521	06559	06595	06633	06670	06707	06744	06781
117	06819	06856	06893	0693	06967	07004	07041	07078	07114	07151
118	07188	07225	07262	07298	07335	07372	07408	07445	07482	07518
119	07555	07591	07628	07664	07700	07737	07773	07809	07846	07882
120	2.07918	2.07954	2.07990	2.08027	2.08063	2.08099	2.08135	2.08171	2.08207	2.08243
121	08278	08314	08350	08386	08422	08458	08493	08529	08565	08600
122	08636	08672	08707	08743	08778	08814	08849	08884	08920	08955
123	08990	09026	09061	09097	09131	09167	09202	09237	09272	09307
124	09342	09377	09412	09447	09482	09517	09552	09587	09621	09656
125	09691	09726	09760	09795	09830	09864	09899	09933	09968	10003
126	10037	10071	10106	10140	10175	10209	10243	10278	10312	10346
127	10380	10414	10449	10483	10517	10551	10585	10619	10653	10687
128	10721	10755	10789	10823	10856	10890	10924	10958	10992	11025
129	11059	11093	11126	11160	11193	11227	11260	11294	11327	11361
130	2.11394	2.11428	2.11461	2.11494	2.11528	2.11561	2.11594	2.11628	2.11661	2.11694
131	11727	11760	11793	11826	11859	11893	11926	11959	11991	12024
132	12057	12090	12123	12156	12189	12222	12254	12287	12320	12352
133	12385	12418	12450	12483	12516	12548	12581	12613	12646	12678
134	12710	12743	12775	12808	12840	12872	12904	12936	12969	13001
135	13033	13065	13098	13130	13162	13194	13226	13258	13290	13322
136	13354	13386	13418	13450	13481	13513	13545	13577	13609	13640
137	13672	13704	13735	13767	13799	13830	13862	13893	13925	13956
138	13988	14019	14051	14082	14114	14145	14176	14208	14239	14270
139	14301	14333	14364	14395	14426	14457	14488	14520	14551	14582
140	2.14613	2.14644	2.14675	2.14706	2.14737	2.14768	2.14798	2.14829	2.14860	2.14891
141	14922	14953	14983	15014	15045	15076	15106	15137	15168	15198
142	15229	15259	15290	15320	15351	15381	15412	15442	15473	15503
143	15534	15564	15594	15625	15655	15685	15715	15746	15776	15806
144	15836	15866	15896	15927	15957	15987	16017	16047	16077	16107
145	16137	16167	16197	16227	16256	16286	16316	16346	16376	16405
146	16435	16465	16495	16524	16554	16584	16613	16643	16673	16702
147	16732	16761	16791	16820	16850	16879	16909	16938	16967	16997
148	17026	17055	17085	17114	17143	17173	17202	17231	17260	17289
149	17319	17348	17377	17406	17435	17464	17493	17522	17551	17580
150	2.17609	2.17638	2.17667	2.17696	2.17725	2.17754	2.17782	2.17811	2.17840	2.17869
151	17898	17926	17955	17984	18013	18041	18070	18099	18127	18156
152	18184	18213	18241	18270	18298	18327	18355	18384	18412	18441
153	18469	18497	18526	18554	18583	18611	18639	18667	18696	18724
154	18752	18780	18808	18837	18865	18893	18921	18949	18977	19005
155	19033	19061	19089	19117	19145	19173	19201	19229	19257	19285
156	19312	19340	19368	19396	19424	19451	19479	19507	19535	19562
157	19590	19618	19645	19673	19700	19728	19756	19783	19811	19838
158	19866	19893	19921	19948	19975	20003	20030	20058	20085	20112
159	20140	20167	20194	20222	20249	20276	20303	20330	20358	20385

No.	0
160	2.2041
161	2068
162	209
163	212
164	214
165	217
166	220
167	222
168	225
169	227
170	2.230
171	233
172	235
173	238
174	240
175	243
176	245
177	247
178	250
179	252
180	2.25
181	25
182	26
183	26
184	26
185	26
186	26
187	27
188	27
189	27
190	2.27
191	28
192	28
193	28
194	28
195	28
196	28
197	28
198	28
199	28
200	2.3
201	3
202	3
203	3
204	3
205	3
206	3
207	3
208	3
209	3
210	2
211	
212	
213	
214	
215	
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219	

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
160	2.20412	2.20439	2.20466	2.20493	2.20520	2.20547	2.20574	2.20602	2.20629	2.20656
161	2.20683	2.20709	2.20736	2.20763	2.20790	2.20817	2.20844	2.20871	2.20898	2.20925
162	2.20951	2.20978	2.21005	2.21032	2.21059	2.21085	2.21112	2.21139	2.21165	2.21192
163	2.21219	2.21245	2.21272	2.21299	2.21325	2.21352	2.21378	2.21405	2.21431	2.21458
164	2.21484	2.21511	2.21537	2.21564	2.21590	2.21617	2.21643	2.21669	2.21696	2.21722
165	2.21748	2.21775	2.21801	2.21827	2.21853	2.21880	2.21906	2.21932	2.21958	2.21985
166	2.22011	2.22037	2.22063	2.22089	2.22115	2.22141	2.22167	2.22194	2.22220	2.22246
167	2.22272	2.22298	2.22324	2.22350	2.22375	2.22401	2.22427	2.22453	2.22479	2.22505
168	2.22531	2.22557	2.22583	2.22608	2.22634	2.22660	2.22686	2.22711	2.22737	2.22763
169	2.22789	2.22814	2.22840	2.22866	2.22891	2.22917	2.22943	2.22968	2.22994	2.23019
170	2.23045	2.23070	2.23096	2.23121	2.23147	2.23172	2.23198	2.23223	2.23249	2.23274
171	2.23300	2.23325	2.23350	2.23376	2.23401	2.23426	2.23452	2.23477	2.23502	2.23528
172	2.23553	2.23578	2.23603	2.23628	2.23654	2.23679	2.23704	2.23729	2.23754	2.23779
173	2.23805	2.23830	2.23855	2.23880	2.23905	2.23930	2.23955	2.23980	2.24005	2.24030
174	2.24055	2.24080	2.24105	2.24130	2.24155	2.24179	2.24204	2.24229	2.24254	2.24279
175	2.24304	2.24329	2.24353	2.24378	2.24403	2.24428	2.24452	2.24477	2.24502	2.24527
176	2.24551	2.24576	2.24601	2.24625	2.24650	2.24674	2.24699	2.24724	2.24748	2.24773
177	2.24797	2.24822	2.24846	2.24871	2.24895	2.24920	2.24944	2.24969	2.24993	2.25018
178	2.25042	2.25066	2.25091	2.25115	2.25139	2.25164	2.25188	2.25212	2.25237	2.25261
179	2.25285	2.25310	2.25334	2.25358	2.25382	2.25406	2.25431	2.25455	2.25479	2.25503
180	2.25527	2.25551	2.25575	2.25600	2.25624	2.25648	2.25672	2.25696	2.25720	2.25744
181	2.25768	2.25792	2.25816	2.25840	2.25864	2.25888	2.25912	2.25935	2.25959	2.25983
182	2.26007	2.26031	2.26055	2.26079	2.26102	2.26126	2.26150	2.26174	2.26198	2.26221
183	2.26245	2.26269	2.26292	2.26316	2.26340	2.26364	2.26387	2.26411	2.26434	2.26458
184	2.26482	2.26505	2.26529	2.26552	2.26576	2.26600	2.26623	2.26647	2.26670	2.26694
185	2.26717	2.26741	2.26764	2.26787	2.26811	2.26834	2.26858	2.26881	2.26905	2.26928
186	2.26951	2.26975	2.26998	2.27021	2.27045	2.27068	2.27091	2.27114	2.27138	2.27161
187	2.27184	2.27207	2.27231	2.27254	2.27277	2.27300	2.27323	2.27347	2.27370	2.27393
188	2.27416	2.27439	2.27462	2.27485	2.27508	2.27531	2.27554	2.27577	2.27600	2.27623
189	2.27646	2.27669	2.27692	2.27715	2.27738	2.27761	2.27784	2.27807	2.27830	2.27852
190	2.27875	2.27898	2.27921	2.27944	2.27967	2.27989	2.28012	2.28035	2.28058	2.28081
191	2.28103	2.28126	2.28149	2.28171	2.28194	2.28217	2.28239	2.28262	2.28285	2.28307
192	2.28330	2.28353	2.28375	2.28398	2.28420	2.28443	2.28466	2.28488	2.28511	2.28533
193	2.28556	2.28578	2.28601	2.28623	2.28646	2.28668	2.28690	2.28713	2.28735	2.28758
194	2.28780	2.28802	2.28825	2.28847	2.28870	2.28892	2.28914	2.28937	2.28959	2.28981
195	2.29003	2.29026	2.29048	2.29070	2.29092	2.29115	2.29137	2.29159	2.29181	2.29203
196	2.29226	2.29248	2.29270	2.29292	2.29314	2.29336	2.29358	2.29380	2.29402	2.29425
197	2.29447	2.29469	2.29491	2.29513	2.29535	2.29557	2.29579	2.29601	2.29623	2.29645
198	2.29666	2.29688	2.29710	2.29732	2.29754	2.29776	2.29798	2.29820	2.29842	2.29863
199	2.29885	2.29907	2.29929	2.29951	2.29972	2.29994	3.00016	3.00038	3.00059	3.00081
200	3.00103	3.00125	3.00146	3.00168	3.00190	3.00211	3.00233	3.00255	3.00276	3.00298
201	3.00320	3.00341	3.00363	3.00384	3.00406	3.00427	3.00449	3.00471	3.00492	3.00514
202	3.00535	3.00556	3.00578	3.00600	3.00621	3.00642	3.00664	3.00685	3.00707	3.00728
203	3.00750	3.00771	3.00792	3.00814	3.00835	3.00856	3.00878	3.00899	3.00920	3.00942
204	3.00963	3.00984	3.01006	3.01027	3.01048	3.01069	3.01091	3.01112	3.01130	3.01154
205	3.01175	3.01197	3.01218	3.01239	3.01260	3.01281	3.01302	3.01323	3.01344	3.01366
206	3.01387	3.01408	3.01429	3.01450	3.01471	3.01492	3.01513	3.01534	3.01555	3.01576
207	3.01597	3.01618	3.01639	3.01660	3.01681	3.01702	3.01723	3.01744	3.01764	3.01785
208	3.01806	3.01827	3.01848	3.01869	3.01890	3.01911	3.01931	3.01952	3.01973	3.01994
209	3.02015	3.02035	3.02056	3.02077	3.02098	3.02118	3.02139	3.02160	3.02180	3.02201
210	3.02222	3.02243	3.02263	3.02284	3.02305	3.02325	3.02346	3.02366	3.02387	3.02408
211	3.02428	3.02449	3.02469	3.02490	3.02510	3.02531	3.02552	3.02572	3.02593	3.02613
212	3.02634	3.02654	3.02674	3.02695	3.02715	3.02736	3.02756	3.02777	3.02797	3.02818
213	3.02838	3.02858	3.02879	3.02899	3.02919	3.02940	3.02960	3.02980	3.03001	3.03021
214	3.03041	3.03062	3.03082	3.03102	3.03122	3.03143	3.03163	3.03185	3.03203	3.03224
215	3.03244	3.03264	3.03284	3.03304	3.03325	3.03345	3.03365	3.03385	3.03405	3.03425
216	3.03445	3.03465	3.03486	3.03506	3.03526	3.03546	3.03566	3.03586	3.03606	3.03626
217	3.03646	3.03666	3.03686	3.03706	3.03726	3.03746	3.03766	3.03786	3.03806	3.03826
218	3.03846	3.03866	3.03885	3.03905	3.03925	3.03945	3.03963	3.03985	3.04005	3.04025
219	3.04044	3.04064	3.04084	3.04104	3.04124	3.04143	3.04163	3.04183	3.04203	3.04222

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
220	2.34242	2.34262	2.34282	2.34301	2.34321	2.34341	2.34360	2.34380	2.34400	2.34420
221	34439	34459	34478	34498	34518	34537	34557	34577	34596	34616
222	34635	34655	34674	34694	34713	34733	34752	34772	34791	34811
223	34830	34850	34869	34889	34908	34928	34947	34967	34986	35005
224	35025	35044	35064	35083	35102	35122	35141	35160	35180	35199
225	35218	35237	35257	35276	35295	35315	35334	35353	35372	35392
226	35411	35430	35449	35468	35488	35507	35526	35545	35564	35583
227	35603	35622	35641	35660	35679	35698	35717	35736	35755	35774
228	35793	35812	35832	35851	35870	35889	35908	35927	35946	35965
229	35983	36002	36021	36040	36059	36078	36097	36116	36135	36154
230	2.36173	2.36192	2.36210	2.36229	2.36248	2.36267	2.36286	2.36305	2.36324	2.36342
231	36361	36380	36399	36418	36436	36455	36474	36493	36511	36530
232	36549	36567	36586	36605	36624	36642	36661	36680	36698	36717
233	36736	36754	36773	36791	36810	36829	36847	36866	36884	36903
234	36922	36940	36959	36977	36996	37014	37033	37051	37070	37088
235	37107	37125	37144	37162	37181	37199	37217	37236	37254	37273
236	37291	37310	37328	37346	37365	37383	37401	37420	37438	37456
237	37475	37493	37511	37530	37548	37566	37585	37603	37621	37639
238	37658	37676	37694	37712	37731	37749	37767	37785	37803	37822
239	37840	37858	37876	37894	37912	37930	37949	37967	37985	38003
240	2.38021	2.38039	2.38057	2.38075	2.38093	2.38111	2.38130	2.38148	2.38166	2.38184
241	38202	38220	38238	38256	38274	38292	38310	38328	38346	38364
242	38381	38399	38417	38435	38453	38471	38489	38507	38525	38543
243	38561	38578	38596	38614	38632	38650	38668	38685	38703	38721
244	38739	38757	38775	38792	38810	38828	38846	38863	38881	38899
245	38917	38934	38952	38970	38987	39005	39023	39040	39058	39076
246	39093	39111	39129	39146	39164	39182	39199	39217	39234	39252
247	39270	39287	39305	39322	39340	39357	39375	39393	39410	39428
248	39445	39463	39480	39500	39515	39533	39550	39568	39585	39602
249	39620	39637	39655	39672	39690	39707	39724	39742	39759	39777
250	2.39794	2.39811	2.39829	2.39846	2.39863	2.39881	2.39898	2.39915	2.39933	2.39950
251	39967	39985	40002	40019	40036	40054	40071	40088	40106	40123
252	40140	40157	40174	40192	40209	40226	40243	40260	40278	40295
253	40312	40329	40346	40363	40381	40398	40415	40432	40449	40466
254	40483	40500	40517	40535	40552	40569	40586	40603	40620	40637
255	40654	40671	40688	40705	40722	40739	40756	40773	40790	40807
256	40824	40841	40858	40875	40892	40909	40926	40943	40959	40976
257	40993	41010	41027	41044	41061	41078	41095	41111	41128	41145
258	41162	41179	41196	41212	41229	41246	41263	41280	41296	41313
259	41330	41347	41363	41380	41397	41414	41430	41447	41464	41481
260	2.41497	2.41514	2.41531	2.41547	2.41564	2.41581	2.41597	2.41614	2.41631	2.41647
261	41664	41681	41697	41714	41731	41747	41764	41780	41797	41813
262	41830	41847	41863	41880	41896	41913	41929	41946	41962	41979
263	41996	42012	42029	42045	42062	42078	42094	42111	42127	42144
264	42160	42177	42193	42210	42226	42243	42259	42275	42292	42308
265	42325	42341	42357	42374	42390	42406	42423	42439	42455	42472
266	42488	42504	42521	42537	42553	42570	42586	42602	42619	42635
267	42651	42667	42684	42700	42716	42732	42749	42765	42781	42797
268	42813	42830	42846	42862	42878	42894	42911	42927	42943	42959
269	42975	42991	43007	43024	43040	43056	43072	43088	43104	43120
270	2.43136	2.43152	2.43168	2.43185	2.43201	2.43217	2.43233	2.43249	2.43265	2.43281
271	43297	43313	43329	43345	43361	43377	43393	43409	43425	43441
272	43457	43473	43489	43505	43521	43537	43553	43568	43584	43600
273	43616	43632	43648	43664	43680	43696	43712	43727	43743	43759
274	43775	43791	43807	43823	43838	43854	43870	43886	43902	43917
275	43933	43949	43965	43981	43996	44012	44028	44044	44059	44075
276	44091	44107	44122	44138	44154	44169	44185	44201	44217	44232
277	44248	44264	44279	44295	44311	44326	44342	44358	44373	44389
278	44404	44420	44435	44451	44467	44482	44498	44514	44529	44545
279	44560	44576	44591	44607	44623	44638	44654	44669	44685	44700

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
280	2.44716	2.44731	2.44747	2.44762	2.44778	2.44793	2.44809	2.44824	2.44840	2.44855
281	44871	44886	44901	44917	44932	44948	44963	44979	44994	45009
282	45025	45040	45056	45071	45086	45102	45117	45132	45148	45163
283	45179	45194	45209	45225	45240	45255	45271	45286	45301	45316
284	45332	45347	45362	45378	45393	45408	45423	45439	45454	45469
285	45484	45500	45515	45530	45545	45561	45576	45591	45606	45622
286	45637	45652	45667	45682	45697	45712	45728	45743	45760	45773
287	45788	45803	45818	45837	45859	45864	45879	45894	45909	45924
288	45939	45954	45969	45984	45999	46015	46030	46045	46060	46075
289	46090	46105	46120	46135	46150	46165	46180	46195	46210	46225
290	2.46240	2.46255	2.46270	2.46285	2.46300	2.46315	2.46329	2.46344	2.46359	2.46374
291	46389	46404	46419	46434	46449	46464	46479	46494	46508	46523
292	46538	46553	46568	46583	46598	46612	46627	46642	46657	46672
293	46687	46702	46716	46731	46746	46761	46776	46790	46805	46820
294	46835	46849	46864	46879	46894	46908	46923	46938	46953	46967
295	46982	46997	47012	47026	47041	47056	47070	47085	47100	47114
296	47129	47144	47158	47173	47188	47202	47217	47232	47246	47261
297	47276	47290	47305	47319	47334	47349	47363	47378	47392	47407
298	47422	47436	47451	47465	47480	47494	47510	47523	47538	47553
299	47567	47582	47596	47611	47625	47640	47654	47669	47683	47698
300	2.47712	2.47727	2.47741	2.47755	2.47770	2.47784	2.47799	2.47813	2.47828	2.47842
301	47857	47871	47885	47900	47914	47929	47943	47957	47972	47986
302	48001	48015	48029	48044	48058	48072	48087	48101	48116	48130
303	48144	48159	48173	48187	48202	48216	48230	48244	48259	48273
304	48287	48302	48316	48330	48344	48359	48373	48387	48401	48416
305	48430	48444	48458	48473	48487	48501	48515	48529	48544	48558
306	48572	48586	48600	48615	48629	48643	48657	48671	48685	48700
307	48714	48728	48742	48756	48770	48784	48799	48813	48827	48841
308	48855	48869	48883	48897	48911	48925	48940	48954	48968	48982
309	48996	49010	49024	49038	49052	49066	49080	49094	49108	49122
310	2.49136	2.49150	2.49164	2.49178	2.49192	2.49206	2.49220	2.49234	2.49248	2.49262
311	49276	49290	49304	49318	49332	49346	49360	49374	49388	49401
312	49415	49429	49443	49457	49471	49485	49499	49513	49527	49541
313	49554	49568	49582	49596	49610	49624	49638	49651	49665	49679
314	49693	49707	49721	49734	49748	49762	49776	49790	49803	49817
315	49831	49845	49859	49872	49886	49900	49914	49927	49941	49955
316	49969	49982	49996	50010	50024	50037	50051	50065	50078	50093
317	50106	50120	50133	50147	50161	50174	50188	50202	50215	50229
318	50243	50256	50270	50284	50297	50311	50325	50338	50352	50365
319	50379	50393	50406	50420	50431	50447	50461	50474	50488	50501
320	2.50515	2.50529	2.50542	2.50556	2.50569	2.50583	2.50596	2.50610	2.50623	2.50637
321	50650	50664	50677	50691	50705	50718	50732	50745	50759	50772
322	50786	50799	50812	50826	50839	50853	50866	50880	50893	50907
323	50920	50934	50947	50961	50974	50987	51001	51014	51028	51041
324	51054	51068	51081	51095	51108	51121	51135	51148	51162	51175
325	51188	51202	51215	51228	51242	51255	51268	51282	51295	51308
326	51321	51335	51348	51362	51375	51388	51402	51415	51428	51451
327	51455	51468	51481	51495	51508	51521	51534	51548	51561	51574
328	51587	51601	51614	51627	51640	51653	51667	51680	51693	51706
329	51720	51733	51746	51759	51772	51785	51799	51812	51825	51838
330	2.51851	2.51864	2.51878	2.51891	2.51904	2.51917	2.51930	2.51943	2.51956	2.51970
331	51983	51996	52009	52022	52035	52048	52061	52074	52088	52101
332	52114	52127	52140	52153	52166	52179	52192	52205	52218	52231
333	52244	52257	52270	52283	52297	52310	52323	52336	52349	52362
334	52375	52388	52401	52414	52427	52440	52453	52466	52478	52491
335	52504	52517	52530	52543	52556	52569	52582	52595	52608	52621
336	52634	52647	52660	52672	52686	52698	52711	52724	52737	52750
337	52763	52776	52789	52802	52814	52827	52840	52852	52866	52879
338	52892	52904	52917	52930	52943	52956	52969	52981	52994	53007
339	53020	53033	53046	53058	53071	53084	53097	53109	53122	53135

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
340	2.53148	2.53161	2.53173	2.53186	2.53199	2.53212	2.53224	2.53237	2.53250	2.53263
341	53275	53288	53301	53314	53326	53339	53352	53364	53377	53390
342	53403	53415	53428	53441	53453	53466	53479	53491	53504	53517
343	53529	53542	53555	53567	53580	53593	53605	53618	53631	53643
344	53656	53668	53681	53694	53706	53719	53731	53744	53757	53769
345	53782	53794	53807	53820	53832	53845	53857	53870	53882	53895
346	53908	53920	53933	53945	53958	53970	53983	53995	54008	54020
347	54033	54045	54058	54070	54083	54095	54108	54120	54133	54145
348	54158	54170	54183	54195	54208	54220	54233	54245	54258	54270
349	54182	54195	54207	54220	54232	54245	54257	54270	54282	54294
350	2.54407	2.54419	2.54432	2.54444	2.54456	2.54469	2.54481	2.54494	2.54506	2.54518
351	54531	54543	54555	54568	54580	54592	54605	54617	54630	54642
352	54654	54667	54679	54691	54704	54716	54728	54740	54753	54765
353	54777	54790	54802	54814	54827	54839	54851	54863	54876	54888
354	54900	54913	54925	54937	54949	54962	54974	54986	54998	55011
355	55023	55035	55047	55059	55072	55084	55096	55108	55121	55133
356	55145	55157	55169	55182	55194	55206	55218	55230	55242	55255
357	55267	55279	55291	55303	55315	55328	55340	55352	55364	55376
358	55388	55400	55413	55425	55437	55449	55461	55473	55485	55497
359	55509	55521	55534	55546	55558	55570	55582	55594	55606	55618
360	2.55630	2.55642	2.55654	2.55666	2.55678	2.55690	2.55703	2.55715	2.55727	2.55739
361	55751	55763	55775	55787	55799	55811	55823	55835	55847	55859
362	55871	55883	55895	55907	55919	55931	55943	55955	55967	55979
363	55991	56003	56015	56026	56039	56050	56062	56074	56086	56098
364	56110	56122	56134	56146	56158	56170	56182	56193	56205	56217
365	56229	56241	56253	56265	56277	56289	56301	56312	56324	56336
366	56348	56360	56372	56384	56395	56407	56419	56431	56443	56455
367	56467	56478	56490	56502	56514	56526	56537	56549	56561	56573
368	56585	56597	56608	56620	56630	56644	56655	56667	56679	56691
369	56703	56714	56726	56738	56750	56761	56773	56785	56797	56808
370	2.56820	2.56832	2.56844	2.56855	2.56867	2.56879	2.56890	2.56902	2.56914	2.56926
371	56937	56949	56961	56972	56984	56996	57008	57019	57031	57043
372	57054	57066	57078	57089	57101	57113	57123	57136	57148	57159
373	57171	57182	57194	57206	57217	57229	57241	57252	57264	57275
374	57287	57299	57310	57322	57334	57345	57357	57368	57380	57391
375	57403	57415	57426	57438	57449	57461	57473	57484	57496	57507
376	57519	57530	57542	57553	57565	57576	57588	57600	57611	57623
377	57634	57646	57657	57669	57680	57692	57703	57715	57726	57738
378	57749	57761	57772	57784	57795	57807	57818	57829	57841	57852
379	57864	57875	57887	57898	57910	57921	57933	57944	57955	57967
380	2.57978	2.57990	2.58001	2.58013	2.58024	2.58035	2.58047	2.58058	2.58070	2.58081
381	58092	58104	58115	58127	58138	58150	58161	58172	58184	58195
382	58206	58218	58229	58240	58252	58263	58274	58286	58297	58308
383	58320	58331	58342	58354	58365	58376	58388	58399	58410	58421
384	58433	58444	58456	58467	58478	58490	58501	58512	58523	58535
385	58546	58557	58569	58580	58591	58602	58614	58625	58636	58647
386	58659	58670	58681	58692	58704	58715	58726	58737	58749	58760
387	58771	58782	58793	58805	58816	58827	58838	58850	58861	58872
388	58883	58894	58905	58917	58928	58939	58950	58961	58973	58984
389	58995	59006	59017	59028	59040	59051	59062	59073	59084	59095
390	2.59106	2.59118	2.59129	2.59140	2.59151	2.59162	2.59173	2.59184	2.59195	2.59207
391	59218	59229	59240	59251	59262	59273	59284	59295	59306	59317
392	59329	59340	59351	59362	59373	59384	59395	59406	59417	59428
393	59439	59450	59461	59472	59483	59494	59505	59516	59528	59539
394	59550	59561	59572	59583	59594	59605	59616	59627	59638	59649
395	59660	59671	59682	59693	59704	59714	59726	59737	59748	59758
396	59769	59780	59791	59802	59813	59824	59835	59846	59857	59868
397	59879	59890	59901	59912	59923	59934	59945	59956	59966	59977
398	59988	59999	60010	60021	60032	60043	60054	60065	60075	60089
399	60097	60108	60119	60130	60140	60152	60162	60173	60184	60195

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
400	2.60206	2.60217	2.60228	2.60239	2.60249	2.6026	2.60271	2.60282	2.60293	2.60304
401	60314	60325	60336	60347	60358	60368	60379	60390	60401	60412
402	60423	60433	60444	60455	60466	60477	60487	60498	60509	60520
403	60530	60541	60552	60563	60574	60584	60595	60606	60617	60627
404	60638	60649	60660	60670	60681	60692	60703	60713	60724	60735
405	60749	60756	60767	60778	60788	60799	60810	60820	60831	60842
406	60853	60863	60874	60885	60895	60906	60917	60927	60938	60949
407	60959	60970	60981	60991	61002	61013	61023	61034	61045	61055
408	61066	61077	61087	61098	61109	61119	61130	61140	61151	61162
409	61172	61183	61194	61204	61215	61225	61236	61247	61257	61268
410	2.61278	2.61289	2.61300	2.61310	2.61321	2.61331	2.61342	2.61352	2.61363	2.61374
411	61384	61395	61405	61416	61426	61437	61447	61458	61469	61479
412	61490	61500	61511	61521	61532	61542	61553	61563	61574	61584
413	61595	61605	61616	61626	61637	61647	61658	61668	61679	61689
414	61700	61710	61721	61731	61742	61752	61763	61773	61784	61794
415	61805	61815	61826	61836	61847	61857	61867	61878	61888	61899
416	61909	61920	61930	61941	61951	61961	61972	61982	61993	62003
417	62014	62024	62034	62045	62055	62066	62076	62086	62097	62107
418	62118	62128	62138	62149	62159	62169	62180	62190	62201	62211
419	62221	62232	62242	62252	62263	62273	62283	62294	62304	62315
420	2.62325	2.62335	2.62346	2.62356	2.62366	2.62377	2.62387	2.62397	2.62408	2.62418
421	62428	62438	62449	62459	62469	62480	62490	62500	62511	62521
422	62531	62541	62552	62562	62572	62583	62593	62603	62613	62624
423	62634	62644	62655	62665	62675	62685	62696	62707	62716	62726
424	62737	62747	62757	62767	62777	62788	62798	62808	62818	62829
425	62839	62849	62859	62869	62880	62890	62900	62910	62921	62931
426	62941	62951	62961	62971	62982	62992	63002	63012	63022	63033
427	63043	63053	63063	63073	63083	63093	63104	63114	63124	63134
428	63144	63154	63165	63175	63185	63195	63205	63215	63225	63235
429	63246	63256	63266	63276	63286	63296	63306	63316	63327	63337
430	2.63347	2.63357	2.63367	2.63377	2.63387	2.63397	2.63407	2.63417	2.63428	2.63438
431	63448	63458	63468	63478	63488	63498	63508	63518	63528	63537
432	63548	63558	63568	63578	63589	63599	63609	63619	63629	63639
433	63649	63659	63669	63679	63689	63699	63709	63719	63729	63739
434	63749	63759	63769	63779	63789	63799	63809	63819	63829	63839
435	63849	63859	63869	63879	63889	63899	63909	63919	63929	63939
436	63949	63959	63969	63978	63988	63998	64008	64018	64028	64038
437	64048	64058	64068	64078	64088	64098	64108	64118	64128	64138
438	64147	64157	64167	64177	64187	64197	64207	64217	64227	64237
439	64246	64256	64266	64276	64286	64296	64306	64316	64325	64335
440	2.64345	2.64355	2.64365	2.64375	2.64385	2.64395	2.64404	2.64414	2.64424	2.64434
441	64444	64454	64463	64473	64483	64493	64503	64513	64522	64532
442	64542	64552	64562	64572	64581	64591	64601	64611	64621	64631
443	64640	64650	64660	64670	64680	64682	64699	64709	64719	64728
444	64738	64748	64758	64768	64777	64787	64797	64807	64816	64826
445	64836	64846	64855	64865	64873	64885	64894	64904	64914	64924
446	64933	64943	64953	64963	64972	64982	64992	65002	65011	65021
447	65031	65040	65050	65060	65070	65079	65089	65099	65108	65118
448	65128	65137	65147	65157	65167	65176	65186	65196	65205	65215
449	65225	65234	65244	65254	65263	65273	65283	65292	65302	65312
450	2.65321	2.65331	2.65340	2.65350	2.65360	2.65369	2.65379	2.65389	2.65398	2.65408
451	65418	65427	65437	65446	65459	65466	65475	65485	65495	65504
452	65514	65523	65533	65543	65552	65562	65571	65581	65591	65600
453	65610	65619	65629	65639	65648	65658	65667	65677	65686	65696
454	65706	65715	65725	65734	65744	65753	65763	65772	65782	65792
455	65801	65811	65820	65830	65839	65849	65858	65868	65877	65887
456	65896	65906	65915	65925	65935	65944	65954	65963	65973	65982
457	65992	66001	66011	66020	66030	66039	66049	66058	66068	66077
458	66086	66096	66105	66115	66124	66134	66143	66153	66162	66172
459	66181	66191	66200	66210	66219	66228	66238	66247	66257	66266

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
460	2.66270	2.66285	2.66295	2.66304	2.66313	2.66323	2.66332	2.66342	2.66351	2.66361
461	66370	66379	66389	66398	66408	66417	66427	66436	66445	66455
462	66464	66474	66483	66492	66502	66511	66521	66530	66539	66549
463	66558	66567	66577	66586	66596	66605	66614	66624	66633	66642
464	66652	66661	66670	66680	66689	66699	66708	66717	66727	66736
465	66745	66755	66764	66773	66783	66792	66801	66811	66820	66829
466	66839	66848	66857	66866	66876	66885	66894	66904	66913	66922
467	66931	66941	66950	66960	66969	66978	66987	66997	67006	67015
468	67025	67034	67043	67052	67062	67071	67080	67089	67099	67108
469	67117	67126	67136	67145	67154	67164	67173	67182	67191	67200
470	2.67210	2.67219	2.67228	2.67237	2.67247	2.67256	2.67265	2.67274	2.67284	2.67293
471	67302	67311	67320	67330	67339	67348	67357	67367	67376	67385
472	67394	67403	67413	67422	67431	67440	67449	67459	67468	67477
473	67486	67495	67504	67514	67523	67532	67541	67550	67559	67569
474	67578	67587	67596	67605	67614	67624	67633	67642	67651	67660
475	67669	67678	67688	67697	67706	67715	67724	67733	67742	67752
476	67761	67770	67779	67788	67797	67806	67815	67824	67834	67843
477	67852	67861	67870	67879	67888	67897	67906	67915	67925	67934
478	67943	67952	67961	67970	67979	67988	67997	68006	68015	68024
479	68033	68043	68052	68061	68070	68079	68088	68097	68106	68115
480	2.68124	2.68133	2.68142	2.68151	2.68160	2.68169	2.68178	2.68187	2.68196	2.68205
481	68214	68223	68233	68242	68251	68260	68269	68278	68287	68296
482	68305	68314	68323	68332	68341	68350	68359	68368	68377	68386
483	68395	68404	68413	68422	68431	68440	68449	68458	68467	68476
484	68484	68493	68502	68511	68520	68529	68538	68547	68556	68565
485	68574	68583	68592	68601	68610	68619	68628	68637	68646	68655
486	68664	68673	68681	68690	68699	68708	68717	68726	68735	68744
487	68753	68762	68771	68780	68788	68797	68806	68815	68824	68833
488	68842	68851	68860	68869	68878	68886	68895	68904	68914	68922
489	68931	68940	68948	68957	68966	68975	68984	68993	69002	69011
490	2.69020	2.69028	2.69037	2.69046	2.69055	2.69064	2.69073	2.69082	2.69090	2.69099
491	69108	69117	69126	69135	69143	69152	69161	69170	69179	69188
492	69196	69205	69214	69223	69232	69241	69249	69258	69267	69276
493	69285	69293	69302	69311	69320	69329	69337	69346	69355	69364
494	69373	69381	69390	69399	69408	69417	69425	69434	69443	69452
495	69460	69469	69478	69487	69496	69504	69513	69522	69531	69539
496	69548	69557	69566	69574	69583	69592	69601	69609	69618	69627
497	69636	69644	69653	69662	69671	69679	69688	69697	69705	69714
498	69723	69732	69740	69749	69758	69766	69775	69784	69793	69801
499	69810	69819	69827	69836	69845	69853	69862	69871	69880	69888
500	2.69897	2.69906	2.69914	2.69923	2.69932	2.69940	2.69949	2.69958	2.69966	2.69975
501	69984	69992	70001	70010	70018	70027	70036	70044	70053	70062
502	70070	70079	70088	70096	70105	70114	70122	70131	70139	70148
503	70157	70165	70174	70183	70191	70200	70209	70217	70226	70234
504	70243	70252	70260	70269	70277	70286	70295	70303	70312	70320
505	70329	70338	70346	70355	70363	70372	70381	70389	70398	70406
506	70415	70424	70432	70441	70449	70458	70466	70475	70484	70492
507	70501	70509	70518	70526	70535	70544	70552	70561	70569	70578
508	70586	70595	70603	70612	70620	70629	70638	70646	70655	70663
509	70672	70680	70689	70697	70706	70714	70723	70731	70740	70748
510	2.70757	2.70765	2.70774	2.70783	2.70791	2.70800	2.70808	2.70817	2.70825	2.70834
511	70842	70851	70859	70868	70876	70885	70893	70901	70910	70918
512	70927	70935	70944	70952	70961	70969	70978	70986	70995	71003
513	71012	71020	71029	71037	71045	71054	71062	71071	71079	71088
514	71096	71105	71113	71122	71130	71138	71147	71155	71164	71172
515	71181	71189	71198	71206	71214	71223	71231	71240	71248	71256
516	71265	71273	71282	71290	71299	71307	71315	71324	71332	71341
517	71349	71357	71366	71374	71383	71391	71399	71408	71416	71425
518	71433	71441	71450	71458	71466	71475	71483	71492	71500	71508
519	71517	71525	71533	71542	71550	71559	71567	71575	71584	71592

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
520	2.71600	2.71609	2.71617	2.71625	2.71634	2.71642	2.71650	2.71650	2.71667	2.71675
521	71684	71692	71700	71709	71717	71725	71734	71742	71750	71759
522	71767	71775	71784	71792	71800	71809	71817	71825	71834	71842
523	71850	71858	71867	71875	71883	71892	71900	71908	71917	71925
524	71933	71941	71950	71958	71966	71975	71983	71991	71999	72008
525	72016	72024	72032	72041	72049	72057	72066	72074	72082	72090
526	72099	72107	72115	72123	72132	72140	72148	72156	72165	72173
527	72181	72189	72198	72201	72214	72222	72230	72239	72247	72255
528	72263	72272	72280	72288	72296	72304	72313	72321	72329	72337
529	72346	72354	72362	72370	72378	72387	72395	72403	72411	72419
530	2.72428	2.72436	2.72444	2.72452	2.72460	2.72469	2.72477	2.72485	2.72493	2.72501
531	72509	72518	72526	72534	72542	72550	72558	72567	72575	72583
532	72591	72599	72607	72616	72624	72632	72640	72648	72656	72665
533	72673	72681	72689	72697	72705	72713	72722	72730	72738	72746
534	72754	72762	72770	72778	72787	72795	72803	72811	72819	72827
535	72835	72843	72852	72860	72868	72876	72884	72892	72900	72908
536	72916	72925	72933	72941	72949	72957	72965	72973	72981	72989
537	72997	73006	73014	73022	73030	73038	73046	73054	73062	73070
538	73078	73086	73094	73102	73111	73119	73127	73135	73143	73151
539	73159	73167	73175	73183	73191	73199	73207	73215	73223	73231
540	2.73239	2.73247	2.73255	2.73263	2.73272	2.73280	2.73288	2.73296	2.73304	2.73312
541	73320	73328	73336	73344	73352	73360	73368	73376	73384	73392
542	73400	73408	73416	73424	73432	73440	73448	73456	73464	73472
543	73480	73488	73496	73504	73512	73520	73528	73536	73544	73552
544	73560	73568	73576	73584	73592	73600	73608	73616	73624	73632
545	73640	73648	73656	73664	73672	73679	73687	73695	73703	73711
546	73719	73727	73735	73744	73751	73759	73767	73775	73783	73791
547	73799	73807	73815	73823	73830	73838	73846	73854	73862	73870
548	73878	73886	73894	73902	73910	73918	73926	73933	73941	73949
549	73957	73965	73973	73981	73989	73997	74005	74013	74020	74028
550	2.74036	2.74044	2.74052	2.74060	2.74068	2.74076	2.74084	2.74091	2.74099	2.74107
551	74115	74123	74131	74139	74147	74155	74162	74170	74178	74186
552	74194	74202	74210	74218	74225	74233	74241	74249	74257	74265
553	74273	74280	74288	74296	74304	74312	74320	74327	74335	74343
554	74351	74359	74367	74374	74382	74390	74398	74406	74414	74421
555	74429	74437	74445	74453	74461	74468	74476	74484	74492	74500
556	74507	74515	74523	74531	74539	74547	74554	74562	74570	74578
557	74586	74593	74601	74609	74617	74624	74632	74640	74648	74656
558	74663	74671	74679	74687	74695	74702	74710	74718	74726	74733
559	74741	74749	74757	74764	74772	74780	74788	74796	74803	74811
560	2.74819	2.74827	2.74834	2.74842	2.74850	2.74858	2.74865	2.74873	2.74881	2.74888
561	74896	74904	74912	74920	74927	74935	74943	74950	74958	74966
562	74974	74981	74989	74997	75005	75012	75020	75028	75035	75043
563	75051	75059	75066	75074	75082	75089	75097	75105	75112	75120
564	75128	75136	75143	75151	75159	75166	75174	75182	75189	75197
565	75205	75213	75220	75228	75236	75243	75251	75259	75266	75274
566	75282	75289	75297	75305	75312	75320	75328	75335	75343	75351
567	75358	75366	75374	75381	75389	75397	75404	75412	75420	75427
568	75435	75442	75450	75458	75465	75473	75481	75488	75496	75504
569	75511	75519	75526	75534	75542	75549	75557	75565	75572	75580
570	2.75587	2.75595	2.75603	2.75610	2.75618	2.75626	2.75633	2.75641	2.75648	2.75656
571	75664	75671	75679	75686	75694	75702	75709	75717	75724	75732
572	75740	75747	75755	75762	75770	75778	75785	75793	75800	75808
573	75815	75823	75831	75838	75846	75853	75861	75868	75876	75884
574	75891	75899	75906	75914	75921	75929	75937	75944	75952	75959
575	75967	75974	75982	75989	75997	76005	76012	76020	76027	76035
576	76043	76050	76057	76065	76072	76080	76087	76095	76102	76110
577	76118	76125	76133	76140	76148	76155	76163	76170	76178	76185
578	76193	76200	76208	76215	76223	76230	76238	76245	76253	76260
579	76268	76275	76283	76290	76298	76305	76313	76320	76328	76335

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
580	2.76343	2.76350	2.76358	2.76365	2.76373	2.76380	2.76388	2.76395	2.76403	2.76410
581	76418	76425	76433	76440	76448	76455	76462	76470	76477	76485
582	76492	76500	76507	76515	76522	76530	76537	76545	76552	76559
583	76567	76574	76582	76589	76597	76604	76612	76619	76626	76634
584	76641	76649	76656	76664	76671	76678	76686	76693	76701	76708
585	76716	76723	76730	76738	76745	76753	76760	76767	76775	76782
586	76790	76797	76805	76812	76819	76827	76834	76842	76849	76856
587	76864	76871	76879	76886	76893	76901	76908	76916	76923	76930
588	76938	76945	76953	76960	76967	76975	76982	76989	76997	77004
589	77012	77019	77026	77034	77041	77048	77056	77063	77070	77078
590	2.77085	2.77093	2.77100	2.77107	2.77115	2.77122	2.77129	2.77137	2.77144	2.77151
591	77159	77166	77173	77181	77188	77195	77203	77210	77217	77225
592	77233	77240	77247	77254	77262	77269	77276	77283	77291	77298
593	77305	77313	77320	77327	77335	77342	77349	77357	77364	77371
594	77379	77386	77393	77401	77408	77415	77422	77430	77437	77444
595	77452	77459	77466	77474	77481	77488	77495	77503	77510	77517
596	77525	77532	77539	77546	77554	77561	77568	77576	77583	77590
597	77597	77605	77612	77619	77627	77634	77641	77648	77656	77663
598	77670	77677	77685	77692	77699	77706	77714	77721	77728	77735
599	77743	77750	77757	77764	77772	77779	77786	77793	77801	77808
600	2.77815	2.77822	2.77830	2.77837	2.77844	2.77851	2.77859	2.77866	2.77873	2.77880
601	77887	77895	77902	77909	77916	77924	77931	77938	77945	77952
602	77960	77967	77974	77981	77988	77996	78003	78010	78017	78025
603	78032	78039	78046	78053	78061	78068	78075	78082	78089	78097
604	78104	78111	78118	78125	78132	78140	78147	78154	78161	78168
605	78176	78183	78190	78197	78204	78211	78219	78226	78233	78240
606	78247	78254	78262	78269	78276	78283	78290	78297	78305	78312
607	78319	78326	78333	78340	78347	78355	78362	78369	78376	78383
608	78390	78398	78405	78412	78419	78426	78433	78440	78447	78455
609	78462	78469	78476	78483	78490	78497	78504	78512	78519	78526
610	2.78533	2.78540	2.78547	2.78554	2.78561	2.78569	2.78576	2.78583	2.78590	2.78597
611	78604	78611	78618	78625	78633	78640	78647	78654	78661	78668
612	78675	78682	78689	78696	78704	78711	78718	78725	78732	78739
613	78746	78753	78760	78767	78774	78781	78789	78796	78804	78810
614	78817	78824	78831	78838	78845	78852	78859	78866	78873	78880
615	78888	78895	78902	78909	78915	78923	78930	78937	78944	78951
616	78958	78965	78972	78979	78986	78993	79000	79007	79014	79021
617	79029	79036	79043	79050	79057	79064	79071	79078	79085	79092
618	79099	79106	79113	79120	79127	79134	79141	79148	79155	79162
619	79169	79176	79183	79190	79197	79204	79211	79218	79225	79232
620	2.79239	2.79246	2.79253	2.79260	2.79267	2.79274	2.79281	2.79288	2.79295	2.79302
621	79309	79316	79323	79330	79337	79344	79351	79358	79365	79372
622	79379	79386	79393	79400	79407	79414	79421	79428	79435	79442
623	79449	79456	79463	79470	79477	79484	79491	79498	79504	79511
624	79518	79525	79532	79539	79546	79553	79560	79567	79574	79581
625	79588	79595	79602	79609	79616	79623	79630	79637	79644	79650
626	79657	79664	79671	79678	79685	79692	79699	79706	79713	79720
627	79727	79734	79741	79747	79754	79761	79767	79775	79782	79789
628	79796	79803	79810	79817	79824	79831	79837	79844	79851	79858
629	79865	79872	79879	79886	79893	79900	79906	79913	79920	79927
630	2.79934	2.79941	2.79948	2.79955	2.79962	2.79969	2.79975	2.79982	2.79989	2.79996
631	80003	80010	80017	80024	80030	80037	80044	80051	80058	80065
632	80072	80079	80085	80092	80099	80106	80114	80120	80127	80133
633	80140	80147	80154	80161	80168	80175	80181	80188	80195	80202
634	80209	80216	80223	80229	80236	80243	80250	80257	80263	80271
635	80277	80284	80291	80298	80305	80312	80318	80325	80332	80339
636	80346	80353	80359	80366	80373	80380	80387	80393	80400	80407
637	80414	80421	80428	80434	80441	80448	80455	80462	80468	80475
638	80482	80489	80496	80502	80509	80516	80523	80530	80536	80543
639	80550	80557	80564	80570	80577	80584	80591	80598	80604	80611

A Table of Logarithms from 1 to 10,000.

No	0	1	2	3	4	5	6	7	8	9
640	2.80618	2.80625	2.80632	2.80638	2.80645	2.80652	2.80659	2.80665	2.80672	2.80679
641	80686	80693	80699	80706	80713	80720	80726	80733	80740	80747
642	80754	80760	80767	80774	80781	80787	80794	80801	80808	80814
643	80821	80828	80835	80841	80848	80855	80862	80868	80875	80882
644	80889	80895	80902	80909	80916	80922	80929	80936	80943	80949
645	80956	80963	80969	80976	80983	80990	80996	81003	81010	81017
646	81023	81030	81037	81043	81050	81057	81064	81070	81077	81084
647	81090	81097	81104	81111	81117	81124	81131	81137	81144	81151
648	81158	81164	81171	81178	81184	81191	81198	81204	81211	81218
649	81224	81231	81238	81244	81251	81258	81265	81271	81278	81285
650	2.81491	2.81298	2.81305	2.81311	2.81318	2.81325	2.81331	2.81338	2.81345	2.81351
651	81358	81365	81371	81378	81385	81391	81398	81405	81411	81418
652	81425	81431	81438	81445	81451	81458	81465	81471	81478	81485
653	81491	81498	81505	81511	81518	81525	81531	81538	81544	81551
654	81558	81564	81571	81578	81584	81591	81598	81604	81611	81617
655	81624	81631	81637	81644	81651	81657	81664	81671	81677	81684
656	81690	81697	81704	81710	81717	81723	81730	81737	81743	81750
657	81757	81763	81770	81776	81783	81790	81796	81803	81809	81816
658	81823	81829	81836	81842	81849	81856	81862	81869	81875	81882
659	81889	81895	81902	81908	81915	81921	81928	81935	81941	81948
660	2.81954	2.81961	2.81968	2.81974	2.81981	2.81987	2.81994	2.82000	2.82007	2.82014
661	82020	82027	82033	82040	82046	82053	82061	82066	82073	82079
662	82086	82092	82099	82105	82112	82119	82125	82132	82138	82145
663	82151	82158	82164	82171	82177	82184	82191	82197	82204	82210
664	82217	82223	82230	82236	82243	82249	82256	82263	82269	82276
665	82282	82289	82295	82302	82308	82315	82321	82328	82334	82341
666	82347	82354	82360	82367	82373	82380	82387	82393	82400	82406
667	82413	82419	82426	82432	82439	82445	82452	82458	82465	82471
668	82478	82484	82491	82497	82504	82510	82517	82523	82530	82536
669	82543	82549	82556	82562	82569	82575	82582	82588	82595	82601
670	2.82607	2.82614	2.82620	2.82627	2.82633	2.82640	2.82646	2.82653	2.82659	2.82666
671	82672	82679	82685	82692	82698	82705	82711	82718	82724	82730
672	82737	82743	82750	82756	82763	82769	82776	82782	82789	82795
673	82802	82808	82814	82821	82827	82834	82840	82847	82853	82859
674	82866	82872	82879	82885	82892	82898	82905	82911	82918	82924
675	82930	82937	82943	82950	82956	82963	82969	82975	82982	82988
676	82995	83001	83008	83014	83020	83027	83033	83040	83046	83052
677	83059	83065	83072	83078	83084	83091	83097	83104	83110	83117
678	83123	83129	83136	83142	83149	83155	83161	83168	83174	83181
679	83187	83193	83200	83206	83213	83219	83225	83232	83238	83245
680	2.83251	2.83257	2.83264	2.83270	2.83276	2.83283	2.83289	2.83296	2.83302	2.83308
681	83315	83321	83327	83334	83340	83347	83353	83359	83366	83372
682	83378	83385	83391	83397	83404	83410	83417	83423	83429	83436
683	83442	83448	83455	83461	83467	83474	83480	83487	83493	83499
684	83506	83512	83518	83525	83531	83537	83544	83550	83556	83563
685	83569	83575	83582	83588	83594	83601	83607	83613	83620	83626
686	83632	83639	83645	83651	83658	83664	83670	83677	83683	83689
687	83696	83702	83708	83715	83721	83727	83734	83740	83746	83753
688	83759	83765	83771	83778	83784	83790	83797	83803	83809	83816
689	83822	83828	83834	83841	83847	83853	83860	83866	83872	83879
690	2.83885	2.83891	2.83897	2.83904	2.83910	2.83916	2.83923	2.83929	2.83935	2.83942
691	83948	83954	83960	83967	83973	83979	83985	83992	83998	84004
692	84011	84017	84023	84029	84036	84042	84048	84055	84061	84067
693	84073	84080	84086	84092	84098	84105	84111	84117	84123	84130
694	84136	84142	84148	84155	84161	84167	84173	84180	84186	84192
695	84198	84205	84211	84217	84223	84230	84236	84242	84248	84255
696	84261	84267	84273	84280	84286	84292	84298	84305	84311	84317
697	84323	84330	84336	84342	84348	84354	84361	84367	84373	84379
698	84386	84392	84398	84404	84410	84417	84423	84429	84435	84442
699	84448	84454	84460	84466	84473	84479	84485	84491	84497	84504

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
700	2.84510	2.84516	2.84522	2.84528	2.84535	2.84541	2.84547	2.84553	2.84559	2.84566
701	84572	84578	84584	84590	84593	84602	84609	84615	84621	84627
702	84634	84640	84646	84652	84658	84665	84671	84677	84683	84689
703	84695	84702	84708	84714	84720	84726	84733	84739	84743	84751
704	84757	84763	84770	84776	84782	84788	84794	84800	84807	84813
705	84819	84825	84831	84837	84843	84850	84856	84862	84868	84874
706	84880	84887	84893	84899	84905	84911	84917	84926	84930	84936
707	84942	84948	84954	84960	84966	84973	84979	84985	84991	84997
708	85003	85009	85016	85022	85028	85034	85040	85046	85052	85058
709	85065	85071	85077	85083	85089	85095	85101	85107	85114	85120
710	2.85126	2.85132	2.85138	2.85144	2.85150	2.85156	2.85163	2.85169	2.85175	2.85181
711	85187	85193	85199	85205	85211	85217	85224	85230	85236	85242
712	85248	85254	85260	85266	85272	85278	85285	85291	85297	85303
713	85309	85315	85321	85327	85333	85339	85345	85352	85358	85364
714	85370	85376	85382	85388	85394	85400	85406	85412	85418	85425
715	85431	85437	85443	85449	85455	85461	85467	85473	85479	85485
716	85491	85497	85503	85509	85516	85522	85528	85534	85540	85546
717	85552	85558	85564	85570	85576	85582	85588	85594	85600	85606
718	85612	85618	85625	85631	85637	85643	85649	85655	85661	85667
719	85673	85679	85685	85691	85697	85703	85709	85715	85721	85727
720	2.85733	2.85739	2.85745	2.85751	2.85757	2.85763	2.85769	2.85775	2.85781	2.85788
721	85794	85799	85806	85812	85818	85824	85830	85836	85842	85848
722	85854	85860	85866	85872	85878	85884	85890	85896	85902	85908
723	85914	85920	85926	85932	85938	85944	85950	85956	85962	85968
724	85974	85980	85986	85992	85998	86004	86010	86016	86022	86028
725	86034	86040	86046	86052	86058	86064	86070	86076	86082	86088
726	86094	86100	86106	86112	86118	86124	86130	86136	86141	86147
727	86153	86159	86165	86171	86177	86183	86189	86195	86201	86207
728	86213	86219	86225	86231	86237	86243	86249	86255	86261	86267
729	86273	86279	86285	86291	86297	86303	86308	86314	86320	86326
730	2.86332	2.86338	2.86344	2.86350	2.86356	2.86362	2.86368	2.86374	2.86380	2.86386
731	86392	86398	86404	86410	86415	86421	86427	86433	86439	86445
732	86451	86457	86463	86469	86475	86481	86487	86493	86499	86504
733	86510	86516	86522	86528	86534	86540	86546	86552	86558	86564
734	86570	86576	86581	86587	86593	86599	86605	86611	86617	86623
735	86629	86635	86641	86646	86652	86658	86664	86670	86676	86682
736	86688	86694	86700	86705	86711	86717	86723	86729	86735	86741
737	86747	86753	86759	86764	86770	86776	86782	86788	86794	86800
738	86806	86812	86817	86823	86829	86835	86841	86847	86853	86859
739	86864	86870	86876	86882	86888	86894	86900	86906	86911	86917
740	2.86923	2.86929	2.86935	2.86941	2.86947	2.86952	2.86958	2.86964	2.86970	2.86976
741	86982	86988	86995	86999	87005	87011	87017	87023	87029	87033
742	87040	87046	87052	87058	87064	87070	87075	87081	87087	87093
743	87099	87105	87111	87116	87122	87128	87134	87140	87146	87151
744	87157	87163	87169	87175	87181	87186	87192	87198	87204	87210
745	87216	87221	87227	87233	87239	87245	87251	87256	87262	87268
746	87274	87280	87286	87291	87297	87303	87309	87315	87320	87326
747	87332	87338	87344	87349	87355	87361	87367	87373	87379	87384
748	87390	87396	87402	87408	87413	87419	87425	87431	87437	87442
749	87448	87454	87460	87466	87471	87477	87483	87489	87495	87500
750	2.87506	2.87512	2.87518	2.87523	2.87529	2.87535	2.87541	2.87547	2.87552	2.87558
751	87564	87570	87576	87581	87587	87593	87599	87604	87610	87616
752	87622	87628	87633	87639	87645	87651	87656	87662	87668	87674
753	87679	87685	87691	87697	87703	87708	87714	87720	87726	87731
754	87737	87743	87749	87754	87760	87766	87772	87777	87783	87789
755	87795	87800	87806	87812	87818	87823	87829	87835	87841	87846
756	87852	87858	87864	87869	87875	87881	87887	87892	87898	87904
757	87910	87915	87921	87927	87932	87938	87944	87950	87953	87961
758	87967	87973	87979	87984	87990	87996	88001	88007	88013	88018
759	88024	88030	88036	88041	88047	88053	88058	88064	88070	88076

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
760	2.88081	2.88087	2.88093	2.88098	2.88104	2.88110	2.88116	2.88121	2.88127	2.88133
761	88138	88144	88150	88156	88161	88167	88173	88178	88184	88190
762	88195	88201	88207	88213	88218	88224	88230	88235	88241	88247
763	88252	88258	88264	88270	88275	88281	88287	88292	88298	88304
764	88309	88315	88321	88326	88332	88338	88343	88349	88355	88360
765	88366	88372	88377	88383	88389	88395	88400	88406	88412	88417
766	88423	88429	88434	88440	88446	88451	88457	88463	88468	88474
767	88478	88485	88491	88497	88502	88508	88513	88519	88525	88530
768	88536	88542	88547	88553	88559	88564	88570	88576	88581	88587
769	88593	88598	88604	88610	88615	88621	88627	88632	88638	88643
770	2.88649	2.88655	2.88660	2.88666	2.88672	2.88677	2.88683	2.88689	2.88694	2.88700
771	88705	88711	88717	88722	88728	88734	88739	88745	88750	88756
772	88762	88767	88773	88779	88784	88790	88795	88801	88807	88812
773	88818	88824	88829	88835	88840	88846	88852	88857	88863	88868
774	88874	88880	88885	88891	88897	88902	88908	88913	88919	88925
775	88930	88936	88941	88947	88954	88958	88964	88969	88975	88981
776	88986	88992	88997	89003	89009	89014	89020	89025	89031	89037
777	89042	89048	89053	89059	89064	89070	89075	89081	89087	89092
778	89098	89104	89109	89115	89120	89126	89131	89137	89143	89148
779	89154	89159	89165	89170	89176	89182	89187	89193	89198	89204
780	2.89209	2.89215	2.89221	2.89226	2.89232	2.89237	2.89243	2.89248	2.89254	2.89260
781	89265	89271	89276	89282	89287	89293	89298	89304	89310	89315
782	89321	89326	89332	89337	89343	89348	89354	89360	89365	89371
783	89376	89382	89387	89393	89398	89404	89409	89415	89421	89426
784	89432	89437	89443	89448	89454	89459	89465	89470	89476	89481
785	89487	89492	89498	89504	89509	89515	89520	89526	89531	89537
786	89542	89548	89553	89559	89564	89570	89575	89581	89586	89592
787	89597	89603	89609	89614	89619	89625	89631	89636	89642	89647
788	89653	89658	89664	89669	89675	89680	89686	89691	89697	89702
789	89708	89713	89719	89724	89730	89735	89741	89746	89752	89757
790	2.89763	2.89768	2.89774	2.89779	2.89785	2.89790	2.89796	2.89801	2.89807	2.89812
791	89818	89823	89829	89834	89840	89845	89851	89856	89862	89867
792	89873	89878	89883	89889	89894	89900	89905	89911	89916	89922
793	89927	89933	89938	89944	89949	89955	89960	89966	89971	89977
794	89982	89988	89993	89998	90004	90009	90015	90020	90026	90031
795	90037	90042	90048	90053	90059	90064	90069	90075	90080	90085
796	90091	90097	90102	90108	90113	90119	90124	90129	90135	90141
797	90146	90151	90157	90162	90168	90173	90179	90184	90189	90195
798	90200	90206	90211	90217	90222	90227	90233	90238	90244	90249
799	90255	90260	90266	90271	90276	90282	90287	90293	90298	90304
800	2.90309	2.90314	2.90320	2.90325	2.90331	2.90336	2.90342	2.90347	2.90352	2.90358
801	90363	90369	90374	90380	90385	90390	90396	90401	90407	90412
802	90417	90423	90428	90434	90439	90445	90450	90455	90461	90466
803	90472	90477	90482	90488	90493	90499	90504	90509	90515	90520
804	90526	90531	90536	90542	90547	90553	90558	90563	90569	90574
805	90580	90585	90590	90596	90601	90606	90612	90617	90623	90628
806	90634	90639	90644	90650	90655	90660	90666	90671	90677	90682
807	90687	90693	90698	90703	90709	90714	90720	90725	90730	90736
808	90741	90747	90752	90757	90763	90768	90773	90779	90784	90789
809	90795	90800	90806	90811	90816	90822	90827	90832	90838	90843
810	2.90849	2.90854	2.90859	2.90865	2.90870	2.90875	2.90881	2.90886	2.90891	2.90897
811	90902	90907	90913	90918	90924	90929	90934	90939	90945	90950
812	90956	90961	90966	90972	90977	90982	90988	90993	90998	91004
813	91009	91014	91020	91025	91030	91036	91041	91046	91052	91057
814	91062	91068	91073	91078	91084	91089	91094	91100	91105	91110
815	91116	91121	91126	91132	91137	91142	91148	91153	91158	91164
816	91169	91174	91180	91185	91190	91196	91201	91206	91212	91217
817	91222	91228	91233	91238	91243	91249	91254	91259	91265	91270
818	91275	91281	91286	91291	91297	91302	91307	91312	91318	91323
819	91328	91334	91339	91344	91350	91355	91360	91365	91371	91376

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9	No.	0
820	2.91381	2.91387	2.91392	2.91397	2.91403	2.91408	2.91413	2.91418	2.91424	2.91429	880	2.94
821	91434	91440	91445	91450	91455	91461	91466	91471	91477	91482	881	2.94
822	91487	91492	91498	91503	91508	91514	91519	91524	91529	91535	882	2.94
823	91540	91545	91551	91556	91561	91566	91572	91577	91582	91587	883	2.94
824	91593	91598	91603	91609	91614	91619	91624	91630	91635	91640	884	2.94
825	91645	91651	91656	91661	91661	91672	91677	91682	91687	91693	885	2.94
826	91698	91703	91709	91714	91716	91724	91730	91735	91740	91745	886	2.94
827	91751	91756	91761	91766	91772	91777	91782	91787	91792	91798	887	2.94
828	91803	91808	91814	91819	91824	91829	91834	91840	91845	91850	888	2.94
829	91855	91861	91866	91871	91876	91882	91887	91892	91897	91903	889	2.94
830	2.91908	2.91913	2.91918	2.91924	2.91929	2.91934	2.91939	2.91944	2.91950	2.91955	890	2.94
831	91960	91965	91974	91976	91981	91986	91991	91997	92002	92007	891	2.94
832	92012	92017	92023	92028	92033	92038	92044	92049	92054	92059	892	2.95
833	92064	92070	92075	92080	92085	92091	92096	92101	92106	92111	893	2.95
834	92117	92122	92127	92132	92137	92143	92148	92153	92158	92163	894	2.95
835	92169	92174	92179	92184	92189	92195	92200	92205	92210	92215	895	2.95
836	92221	92226	92231	92236	92241	92247	92252	92257	92262	92267	896	2.95
837	92273	92278	92283	92288	92293	92298	92304	92309	92314	92319	897	2.95
838	92324	92330	92335	92340	92345	92350	92355	92361	92366	92371	898	2.95
839	92376	92381	92387	92392	92397	92402	92407	92412	92418	92423	899	2.95
840	2.92428	2.92433	2.92438	2.92443	2.92449	2.92454	2.92459	2.92464	2.92469	2.92474	900	2.95
841	92480	92485	92490	92495	92500	92505	92511	92516	92521	92526	901	2.95
842	92532	92536	92542	92547	92552	92557	92562	92567	92572	92578	902	2.95
843	92583	92588	92593	92598	92603	92609	92614	92619	92624	92629	903	2.95
844	92634	92639	92645	92650	92655	92660	92665	92670	92675	92680	904	2.95
845	92686	92691	92696	92701	92706	92711	92716	92722	92727	92732	905	2.95
846	92737	92742	92747	92752	92758	92763	92768	92773	92778	92783	906	2.95
847	92788	92793	92799	92804	92810	92814	92819	92824	92829	92834	907	2.95
848	92840	92845	92850	92855	92860	92865	92870	92875	92881	92886	908	2.95
849	92891	92896	92901	92906	92911	92916	92921	92927	92932	92937	909	2.95
850	2.92942	2.92947	2.92952	2.92957	2.92962	2.92967	2.92973	2.92978	2.92983	2.92988	910	2.95
851	92993	92998	93003	93008	93013	93018	93024	93029	93034	93039	911	2.95
852	93044	93049	93054	93059	93064	93069	93075	93080	93085	93090	912	2.95
853	93095	93100	93105	93110	93115	93120	93125	93131	93136	93141	913	2.96
854	93146	93151	93156	93161	93166	93171	93176	93181	93186	93192	914	2.96
855	93197	93202	93207	93212	93217	93222	93227	93232	93237	93242	915	2.96
856	93247	93252	93257	93263	93268	93273	93278	93283	93288	93293	916	2.96
857	93298	93303	93308	93313	93318	93323	93328	93334	93339	93344	917	2.96
858	93349	93354	93359	93364	93369	93374	93379	93384	93389	93394	918	2.96
859	93399	93404	93409	93414	93420	93425	93430	93435	93440	93445	919	2.96
860	2.93450	2.93455	2.93460	2.93465	2.93470	2.93475	2.93480	2.93485	2.93490	2.93495	920	2.96
861	93500	93505	93510	93515	93520	93526	93531	93536	93541	93546	921	2.96
862	93551	93556	93561	93566	93571	93576	93581	93586	93591	93596	922	2.96
863	93601	93606	93611	93616	93621	93626	93631	93636	93641	93646	923	2.96
864	93651	93656	93661	93666	93671	93676	93681	93687	93692	93697	924	2.96
865	93702	93707	93712	93717	93722	93727	93732	93737	93742	93747	925	2.96
866	93752	93757	93762	93767	93772	93777	93782	93787	93792	93797	926	2.96
867	93802	93807	93812	93817	93822	93827	93832	93837	93842	93847	927	2.96
868	93852	93857	93862	93867	93872	93877	93882	93887	93892	93897	928	2.96
869	93902	93907	93912	93917	93922	93927	93932	93937	93942	93947	929	2.96
870	2.93952	2.93957	2.93962	2.93967	2.93972	2.93977	2.93982	2.93987	2.93992	2.93997	930	2.96
871	94002	94007	94012	94017	94022	94027	94032	94037	94042	94047	931	2.96
872	94052	94057	94062	94067	94072	94077	94081	94086	94091	94096	932	2.96
873	94101	94106	94111	94116	94121	94126	94131	94136	94141	94146	933	2.96
874	94151	94156	94161	94166	94171	94176	94181	94186	94191	94196	934	2.96
875	94201	94206	94211	94216	94221	94226	94231	94235	94240	94245	935	2.96
876	94250	94255	94260	94265	94270	94275	94280	94285	94290	94295	936	2.96
877	94300	94305	94310	94315	94320	94325	94330	94335	94340	94345	937	2.96
878	94349	94354	94359	94364	94369	94374	94379	94384	94389	94394	938	2.96
879	94399	94404	94409	94414	94419	94424	94429	94433	94438	94443	939	2.96

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
880	2.94448	2.94453	2.94458	2.94463	2.94468	2.94473	2.94478	2.94483	2.94488	2.94493
881	94498	94501	94507	94512	94517	94522	94527	94532	94537	94542
882	94547	94552	94557	94562	94567	94571	94576	94581	94586	94591
883	94596	94601	94606	94611	94616	94621	94626	94630	94635	94640
884	94645	94650	94655	94660	94665	94670	94675	94680	94685	94689
885	94694	94699	94704	94709	94714	94719	94724	94729	94734	94738
886	94743	94748	94753	94758	94763	94768	94773	94778	94783	94787
887	94792	94797	94802	94807	94812	94817	94822	94827	94832	94836
888	94841	94846	94851	94856	94861	94866	94871	94876	94880	94885
889	94890	94895	94900	94905	94910	94915	94919	94924	94929	94934
890	2.94939	2.94944	2.94949	2.94953	2.94959	2.94963	2.94968	2.94973	2.94978	2.94983
891	94988	94993	94997	95002	95007	95012	95017	95022	95027	95032
892	95036	95041	95046	95051	95056	95061	95066	95071	95075	95080
893	95085	95090	95095	95100	95105	95109	95114	95119	95124	95129
894	95134	95139	95143	95148	95153	95158	95163	95168	95173	95177
895	95182	95187	95192	95197	95202	95207	95211	95216	95221	95226
896	95231	95236	95240	95245	95250	95255	95260	95265	95270	95274
897	95279	95284	95289	95294	95299	95303	95308	95313	95318	95323
898	95328	95332	95337	95342	95347	95352	95357	95361	95366	95371
899	95376	95381	95386	95390	95395	95400	95405	95410	95415	95419
900	2.95424	2.95429	2.95434	2.95439	2.95444	2.95448	2.95453	2.95458	2.95463	2.95468
901	95472	95477	95482	95487	95492	95497	95501	95506	95511	95516
902	95521	95525	95530	95535	95540	95545	95550	95554	95559	95564
903	95569	95574	95578	95583	95588	95593	95598	95602	95607	95612
904	95617	95622	95626	95631	95636	95641	95646	95650	95655	95660
905	95665	95670	95674	95679	95684	95689	95694	95698	95703	95708
906	95713	95718	95722	95727	95732	95737	95742	95746	95751	95756
907	95761	95765	95770	95775	95780	95785	95789	95794	95799	95804
908	95809	95813	95818	95823	95828	95832	95837	95842	95847	95852
909	95856	95861	95866	95871	95875	95880	95885	95890	95895	95899
910	2.95904	2.95909	2.95914	2.95918	2.95923	2.95928	2.95933	2.95938	2.95942	2.95947
911	95952	95957	95961	95966	95971	95976	95980	95985	95990	95995
912	95999	96004	96009	96014	96019	96023	96028	96033	96038	96042
913	96047	96052	96057	96061	96066	96071	96076	96080	96085	96090
914	96095	96099	96104	96109	96114	96118	96123	96128	96133	96137
915	96142	96147	96152	96156	96161	96166	96171	96175	96180	96185
916	96189	96194	96199	96204	96208	96213	96218	96223	96227	96232
917	96237	96242	96246	96251	96256	96261	96265	96270	96275	96280
918	96284	96289	96293	96298	96303	96308	96313	96317	96322	96327
919	96331	96336	96341	96346	96350	96355	96360	96365	96369	96374
920	2.96379	2.96384	2.96388	2.96393	2.96398	2.96402	2.96407	2.96412	2.96417	2.96421
921	96426	96431	96435	96440	96445	96450	96454	96459	96464	96468
922	96473	96478	96483	96487	96492	96497	96501	96506	96511	96515
923	96520	96525	96530	96534	96539	96544	96548	96553	96558	96562
924	96567	96572	96577	96581	96586	96591	96595	96600	96605	96609
925	96614	96619	96624	96628	96633	96638	96642	96647	96652	96656
926	96661	96666	96670	96675	96680	96685	96689	96694	96699	96703
927	96708	96713	96717	96722	96727	96731	96733	96741	96745	96750
928	96755	96759	96764	96769	96774	96778	96783	96788	96792	96797
929	96802	96806	96811	96816	96820	96825	96830	96834	96839	96844
930	2.96848	2.96853	2.96858	2.96862	2.96867	2.96872	2.96876	2.96881	2.96886	2.96890
931	96895	96900	96904	96909	96914	96918	96923	96928	96932	96937
932	96942	96946	96951	96956	96960	96965	96970	96974	96979	96984
933	96988	96993	96997	97002	97007	97011	97016	97021	97025	97030
934	97035	97039	97044	97049	97053	97058	97063	97067	97072	97077
935	97081	97086	97090	97095	97100	97104	97109	97114	97118	97123
936	97128	97132	97137	97141	97146	97151	97155	97160	97165	97169
937	97174	97179	97183	97188	97192	97197	97202	97206	97211	97216
938	97220	97225	97230	97234	97239	97243	97248	97253	97257	97262
939	97267	97271	97276	97280	97285	97290	97294	97299	97304	97308

A Table of Logarithms from 1 to 10,000.

No.	0	1	2	3	4	5	6	7	8	9
940	2. 97313	2. 97317	2. 97322	2. 97326	2. 97331	2. 97336	2. 9734	97345	2. 97350	2. 97354
941	97359	97364	97368	97373	97377	97382	97387	97391	97396	97400
942	97405	97410	97414	97419	97423	97428	97433	97437	97442	97447
943	97451	97456	97460	97465	97470	97474	97479	97483	97488	97493
944	97497	97502	97506	97511	97516	97520	97525	97529	97534	97539
945	97544	97548	97552	97557	97562	97566	97571	97575	97580	97585
946	97589	97594	97598	97603	97607	97612	97617	97621	97626	97630
947	97635	97640	97644	97649	97653	97658	97663	97667	97672	97676
948	97681	97685	97690	97695	97699	97704	97708	97713	97717	97722
949	97727	97731	97736	97740	97745	97749	97754	97759	97763	97768
950	2. 97772	2. 97777	2. 97782	2. 97786	2. 97791	2. 97795	2. 97800	2. 97804	2. 97809	2. 97813
951	97818	97823	97827	97832	97836	97841	97845	97850	97855	97859
952	97864	97868	97873	97877	97882	97886	97891	97896	97900	97905
953	97909	97914	97918	97923	97928	97932	97937	97941	97946	97950
954	97955	97959	97964	97968	97973	97978	97982	97987	97999	97996
955	98000	98005	98009	98014	98018	98023	98028	98032	98037	98041
956	98046	98050	98055	98059	98064	98068	98073	98078	98082	98087
957	98091	98096	98100	98105	98109	98114	98118	98123	98127	98132
958	98137	98141	98146	98150	98155	98159	98164	98168	98173	98177
959	98182	98186	98191	98195	98200	98204	98209	98214	98218	98223
960	2. 98227	2. 98232	2. 98236	2. 98241	2. 98245	2. 98250	2. 98254	2. 98259	2. 98263	2. 98268
961	98272	98277	98281	98286	98290	98295	98299	98304	98308	98313
962	98317	98322	98327	98331	98336	98340	98345	98349	98354	98358
963	98363	98367	98372	98376	98381	98385	98390	98394	98399	98403
964	98408	98412	98417	98421	98426	98430	98435	98439	98444	98448
965	98453	98457	98462	98466	98471	98475	98480	98484	98489	98493
966	98498	98502	98507	98511	98516	98520	98525	98529	98534	98538
967	98543	98547	98552	98556	98561	98565	98570	98574	98579	98583
968	98588	98592	98596	98601	98605	98610	98614	98619	98623	98628
969	98632	98637	98641	98646	98650	98655	98659	98664	98668	98673
970	2. 98677	2. 98682	2. 98686	2. 98691	2. 98695	2. 98700	2. 98704	2. 98709	2. 98713	2. 98717
971	98722	98726	98731	98735	98740	98744	98749	98753	98758	98762
972	98767	98771	98776	98780	98784	98789	98793	98798	98802	98807
973	98811	98816	98820	98825	98829	98834	98838	98843	98847	98851
974	98856	98860	98865	98869	98874	98878	98883	98887	98891	98896
975	98900	98905	98909	98914	98918	98923	98927	98932	98936	98941
976	98945	98949	98954	98958	98963	98967	98972	98976	98981	98985
977	9898	98994	98998	99003	99007	99012	99016	99021	99025	99029
978	99034	99038	99043	99047	99052	99056	99061	99065	99069	99074
979	99078	99083	99087	99092	99096	99100	99105	99109	99114	99118
980	2. 99123	2. 99127	2. 99131	2. 99136	2. 99140	2. 99145	2. 99149	2. 99154	2. 99158	2. 99162
981	99167	99171	99176	99180	99185	99189	99193	99198	99202	99207
982	99211	99216	99220	99224	99229	99233	99238	99242	99246	99251
983	99265	99269	99274	99278	99283	99287	99292	99296	99301	99305
984	99300	99304	99308	99313	99317	99322	99326	99330	99335	99339
985	99344	99348	99352	99357	99361	99366	99370	99374	99379	99383
986	99388	99392	99396	99401	99405	99410	99414	99419	99423	99427
987	99432	99436	99441	99445	99449	99454	99458	99462	99467	99471
988	99476	99480	99484	99489	99493	99498	99502	99506	99511	99515
989	99520	99524	99528	99533	99537	99542	99546	99550	99555	99559
990	2. 99563	2. 99568	2. 99572	2. 99577	2. 99581	2. 99585	2. 99590	2. 99594	2. 99599	2. 99603
991	99607	99612	99616	99621	99625	99629	99634	99638	99642	99647
992	99651	99656	99660	99664	99669	99673	99677	99682	99686	99691
993	99695	99699	99704	99708	99712	99717	99721	99726	99730	99734
994	99739	99743	99747	99752	99756	99760	99765	99769	99774	99778
995	99782	99787	99791	99795	99800	99804	99808	99813	99817	99822
996	99826	99830	99835	99839	99843	99848	99852	99856	99861	99865
997	99870	99874	99878	99883	99887	99891	99896	99900	99904	99909
998	99913	99917	99922	99926	99930	99935	99939	99943	99948	99952
999	99959	99961	99965	99977	99974	99978	99983	99980	99971	99996

A Table of Artificial Sines, Tang. and Sec. 0 Degree.

M.	Sine.	Co Sine.	Tang.	Co. Tang.	Secant.	Co-secant.	
0	0.00000	10.00000	0.00000	Infinite.	10.00000	Infinite.	60
1	6.46373	10.00000	6.46373	13.55627	10.00000	13.55627	59
2	76476	00000	76476	23524	00000	23524	58
3	94085	00000	94085	05915	00000	05915	57
4	7.6579	00000	7.6579	12.93421	00000	12.93421	56
5	16270	00000	16270	83730	00000	83730	55
6	24188	00000	24188	75812	00000	75812	54
7	30882	00000	30882	69118	00000	69118	53
8	36681	00000	36681	63318	00000	63318	52
9	41797	00000	41797	58203	00000	58203	51
10	46373	00000	46373	53627	00000	53627	50
11	7.40512	10.00000	7.50512	12.49488	10.00000	12.49488	49
12	54291	00000	54291	45709	00000	45709	48
13	57767	00000	57767	42233	00000	42233	47
14	60985	00000	60985	39014	00000	39015	46
15	63982	00000	63982	36018	00000	36018	45
16	66784	00000	66785	33215	00000	33216	44
17	69417	9.99999	69418	30582	00001	30583	43
18	71900	99999	71900	28100	00001	28100	42
19	74248	99999	74248	25752	00001	25752	41
20	76475	99999	76476	23524	00001	23525	40
21	7.78594	9.99999	7.78595	12.21405	10.00001	12.21406	39
22	80615	99999	80615	19385	00001	19385	38
23	82545	99999	82546	17154	00001	17455	37
24	84393	99999	84394	15606	00001	15607	36
25	86166	99999	86167	13833	00001	13834	35
26	87870	99999	87871	12130	00001	12130	34
27	89509	99999	89510	10490	00001	10491	33
28	92088	99999	92089	08911	00001	08912	32
29	94612	99999	94613	07387	00002	07388	31
30	97084	99999	97085	05914	00002	05915	30
31	7.95508	9.99998	7.95510	12.04490	10.00002	12.04492	29
32	96887	99998	96888	03111	00002	03133	28
33	98223	99998	98225	01775	00002	01777	27
34	99520	99998	99522	00478	00002	00480	26
35	8.00779	99998	8.00781	11.99219	00002	11.99211	25
36	02002	99998	02004	97996	00002	97998	24
37	03192	99997	03194	96805	00003	96808	23
38	04350	99997	04353	95647	00003	95650	22
39	05478	99997	05481	94519	00003	94522	21
40	06578	99997	06581	93419	00003	93422	20
41	8.07650	9.99997	8.07653	11.92347	10.00003	11.92350	19
42	08696	99997	08700	91300	00003	91304	18
43	09718	99997	09722	90278	00003	90281	17
44	10717	99996	10720	89280	00004	89283	16
45	11693	99996	11696	88304	00004	88307	15
46	12647	99996	12651	87349	00004	87356	14
47	13581	99996	13585	86415	00004	86419	13
48	14495	99996	14500	85500	00004	85505	12
49	15391	99996	15395	84605	00004	84609	11
50	16268	99995	16273	83727	00005	83732	10
51	8.17128	9.99995	8.17132	11.82867	12.00005	11.82872	9
52	17971	99995	17976	82024	00005	82029	8
53	18798	99995	18804	81196	00005	81202	7
54	19610	99995	19616	80384	00005	80390	6
55	20407	99994	20413	79587	00006	79593	5
56	21180	99994	21185	78805	00006	78811	4
57	21938	99994	21964	78036	00006	78042	3
58	22713	99994	22719	77280	00006	77286	2
59	23456	99994	23462	76538	00006	76544	1
60	24186	99993	24192	75808	00006	75814	0
	Co-sine.	Sine.	Co-Tan.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 1 Degree.

M.	Sine.	Co-sine.	Tang.	Co-Tang.	Secant.	Co-secant	
0	8.24185	9.99993	8.24192	11.75808	10.00007	11.75814	60
1	24903	99993	24910	75090	00007	75097	59
2	25609	99993	25616	74383	00007	74391	58
3	26304	99993	26311	73688	00007	73696	57
4	26988	99992	26996	73004	00007	73012	56
5	27661	99992	27666	72331	00008	72339	55
6	28324	99992	28332	71668	00008	71676	54
7	28977	99992	28985	71014	00008	71023	53
8	29621	99991	29629	70371	00008	70379	52
9	30255	99991	30263	69737	00009	69745	51
10	8.30879	9.99991	8.30888	11.69112	10.00009	11.69121	50
11	31495	99991	31505	68495	00009	68505	49
12	32103	99990	32112	67888	00009	67897	48
13	32702	99990	32711	67289	00000	67298	47
14	33292	99990	33302	66697	00010	66708	46
15	33875	99989	33886	66114	00010	66125	45
16	34450	99989	34461	65539	00011	65550	44
17	35018	99989	35029	64971	00011	64982	43
18	35578	99989	35589	64410	00011	64422	42
19	36131	99989	36143	63857	00011	63868	41
20	8.36678	9.99988	8.36689	11.63310	10.00012	11.63322	40
21	37217	99988	37229	62771	00012	62783	39
22	37750	99988	37762	62238	00012	62250	38
23	38276	99987	38289	61711	00013	61724	37
24	38796	99987	38809	61191	00013	61204	36
25	39310	99987	39323	60677	00013	60690	35
26	39818	99986	39831	60168	00014	60182	34
27	40320	99986	40334	59666	00014	59680	33
28	40816	99986	40830	59170	00014	59184	32
29	41307	99985	41321	58679	00015	58693	31
30	8.41792	9.99985	8.41807	11.58193	10.00015	11.58208	30
31	42272	99985	42287	57713	00015	57728	29
32	42746	99984	42762	57238	00016	57254	28
33	43216	99984	43231	56768	00016	56784	27
34	43680	99984	43696	56304	00016	56320	26
35	44139	99983	44156	55844	00017	55861	25
36	44594	99983	44611	55389	00017	55406	24
37	45044	99983	45061	54939	00017	54956	23
38	45489	99982	45507	54493	00018	54510	22
39	45930	99982	45948	54052	00018	54070	21
40	8.46366	9.99982	8.46385	11.53615	10.00018	11.53633	20
41	46798	99981	46817	53183	00019	53201	19
42	47226	99981	47245	52755	00019	52774	18
43	47650	99980	47669	52331	00019	52350	17
44	48069	99980	48089	51911	00020	51931	16
45	48485	99980	48505	51495	00020	51515	15
46	48896	99979	48917	51083	00021	51104	14
47	49304	99979	49325	50675	00021	50696	13
48	49708	99979	49729	50271	00021	50292	12
49	50108	99978	50130	49870	00022	49892	11
50	8.50504	9.99978	8.50527	11.49473	10.00022	11.49495	10
51	50897	99977	50920	49080	00023	49103	9
52	51287	99977	51310	48690	00023	48713	8
53	51673	99976	51696	48304	00023	48328	7
54	52055	99976	52079	47921	00024	47945	6
55	52434	99976	52459	47541	00024	47566	5
56	52810	99975	52835	47165	00025	47190	4
57	53183	99975	53208	46792	00025	46817	3
58	53552	99974	53578	46422	00026	46448	2
59	53919	99974	53945	46055	00026	46081	1
60	54282	99973	54308	45692	00026	45718	0
	Co-sine.	Sine.	Co-tang.	Tang.	Co-secant.	Secant.	M.

88 Degrees.

A Table of Artificial Sines, Tang. and Sec. 2 Degrees.

M.	Sine.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant.	
0	8.54282	9.99973	8.54309	11.45692	10.00026	11.45718	60
1	54042	99973	54669	45331	00027	45358	59
2	54999	99973	55027	44973	00027	45000	58
3	55354	99972	55382	44618	00028	44646	57
4	55705	99972	55734	44266	00028	44295	56
5	56054	99971	56083	43917	00029	43946	55
6	56400	99971	56429	43572	00029	43600	54
7	56743	99970	56773	43227	00030	43257	53
8	57084	99970	57114	42886	00030	42916	52
9	57421	99970	57452	42548	00030	42579	51
10	8.57757	9.99969	8.57788	11.42212	10.00031	11.42243	50
11	58089	99968	58121	41879	00031	41911	49
12	58419	99968	58451	41549	00032	41581	48
13	58747	99967	58779	41221	00032	41253	47
14	59072	99967	59105	40895	00033	40927	46
15	59395	99966	59428	40572	00033	40605	45
16	59715	99966	59749	40251	00034	40283	44
17	60033	99965	60068	39932	00034	39967	43
18	60349	99965	60384	39616	00035	39651	42
19	60662	99964	60698	39302	00035	39338	41
20	8.60973	9.99964	8.61009	11.38991	10.00036	11.39027	40
21	61282	99963	61319	38681	00036	38718	39
22	61589	99963	61626	38374	00037	38411	38
23	61894	99962	61931	38069	00038	38106	37
24	62196	99962	62234	37766	00038	37804	36
25	62496	99961	62535	37465	00039	37503	35
26	62795	99961	62834	37166	00039	37205	34
27	63091	99960	63131	36869	00040	36909	33
28	63385	99960	63426	36574	00040	36615	32
29	63678	99959	63718	36281	00040	36322	31
30	8.63968	9.99959	8.64009	11.35991	10.00041	11.36032	30
31	64256	99958	64298	35702	00042	35744	29
32	64543	99957	64585	35415	00042	35457	28
33	64827	99957	64870	35130	00043	35173	27
34	65110	99956	65154	34846	00044	34890	26
35	65391	99956	65435	34565	00044	34609	25
36	65670	99955	65715	34285	00045	34330	24
37	65947	99955	65993	34007	00045	34052	23
38	66223	99954	66269	33731	00046	33777	22
39	66497	99953	66543	33457	00046	33503	21
40	8.66769	9.99953	8.66816	11.33184	10.00047	11.33231	20
41	67039	99952	67087	32913	00048	32961	19
42	67308	99952	67356	32644	00048	32692	18
43	67575	99951	67624	32376	00049	32425	17
44	67840	99951	67890	32110	00049	32160	16
45	68104	99950	68154	31846	00050	31896	15
46	68366	99949	68417	31583	00051	31633	14
47	68627	99949	68678	31322	00051	31373	13
48	68886	99948	68938	31062	00052	31114	12
49	69144	99947	69196	30804	00052	30856	11
50	8.69400	9.99947	8.69453	11.30547	10.00053	11.30600	10
51	69654	99946	69708	30292	00054	30346	9
52	69907	99946	69962	30038	00054	30093	8
53	70159	99945	70214	29786	00055	29841	7
54	70409	99944	70465	29535	00056	29591	6
55	70658	99944	70714	29286	00056	29342	5
56	70905	99943	70962	29038	00057	29094	4
57	71151	99942	71208	28792	00058	28849	3
58	71395	99942	71453	28546	00058	28605	2
59	71638	99941	71697	28303	00059	28361	1
60	71880	99940	71940	28060	00059	28120	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 3 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	8.71880	9.99940	8.71940	11.28060	10.00059	11.28120	60
1	72120	99940	72181	27819	00060	27880	59
2	72359	99939	72420	27580	00061	27640	58
3	72597	99938	72659	27341	00062	27403	57
4	72834	99938	72896	27104	00062	27166	56
5	73069	99937	73132	26868	00063	26931	55
6	73303	99936	73366	26634	00064	26697	54
7	73535	99936	73600	26400	00064	26465	53
8	73767	99935	73832	26168	00065	26233	52
9	73997	99934	74063	25937	00065	26003	51
10	8.74226	9.99934	8.74292	11.25708	10.00066	11.25774	50
11	74454	99933	74521	25479	00067	25546	49
12	74680	99932	74748	25252	00068	25320	48
13	74905	99931	74974	25026	00068	25094	47
14	75130	99931	75199	24801	00069	24870	46
15	75353	99930	75423	24577	00070	24647	45
16	75575	99929	75645	24355	00070	24425	44
17	75795	99929	75867	24133	00071	24204	43
18	76015	99928	76087	23913	00072	23985	42
19	76234	99927	76306	23693	00073	23766	41
20	8.76451	9.99926	8.76525	11.23475	10.00073	11.23549	40
21	76667	99926	76742	23258	00074	23332	39
22	76883	99925	76958	23042	00075	23117	38
23	77097	99924	77173	22827	00076	22903	37
24	77310	99923	77387	22613	00076	22690	36
25	77522	99923	77599	22400	00077	22478	35
26	77733	99922	77811	22189	00078	22267	34
27	77943	99921	78022	21978	00079	22057	33
28	78152	99920	78253	21768	00079	21848	32
29	78360	99920	78441	21559	00080	21639	31
30	8.78567	9.99919	8.78649	11.21351	10.00081	11.21432	30
31	78774	99919	78855	21145	00082	21226	29
32	78979	99917	79061	20939	00083	21021	28
33	79183	99917	79266	20734	00083	20817	27
34	79386	99916	79470	20530	00084	20614	26
35	79588	99915	79673	20327	00085	20412	25
36	79789	99914	79875	20125	00086	20211	24
37	79990	99913	80076	19924	00087	20010	23
38	80189	99913	80276	19723	00087	19811	22
39	80388	99912	80476	19523	00088	19612	21
40	8.80585	9.99911	8.80674	11.19326	10.00089	11.19415	20
41	80782	99910	80872	19128	00090	19218	19
42	80978	99909	81068	18932	00091	19022	18
43	81173	99909	81264	18736	00091	18827	17
44	81367	99908	81459	18541	00092	18633	16
45	81560	99907	81653	18347	00093	18440	15
46	81752	99906	81846	18154	00094	18248	14
47	81944	99905	82038	17962	00095	18056	13
48	82134	99904	82230	17770	00096	17866	12
49	82324	99904	82420	17579	00097	17676	11
50	8.82513	9.99903	8.82610	11.17390	10.00097	11.17487	10
51	82701	99902	82799	17101	00098	17299	9
52	82888	99901	82987	17013	00099	17112	8
53	83075	99900	83175	16825	00100	16925	7
54	83261	99899	83361	16639	00101	16739	6
55	83446	99898	83547	16453	00102	16554	5
56	83630	99898	83732	16268	00102	16370	4
57	83813	99897	83916	16084	00103	16187	3
58	83996	99896	84100	15900	00104	16004	2
59	84177	99895	84282	15717	00105	15823	1
60	84358	99894	84464	15536	00106	15642	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.	

86 Degrees.

A Table of Artificial Sines, Tang. and Sec. 4 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	8.84358	9.99894	8.84464	11.15536	10.00106	11.15042	60
1	84539	99893	84645	13355	00107	15461	59
2	84718	99892	84825	15175	00108	15282	58
3	84897	99891	85006	14995	00109	15103	57
4	85075	99890	85185	14814	00109	14925	56
5	85252	99890	85363	14637	00110	14748	55
6	85429	99889	85540	14460	00111	14571	54
7	85605	99888	85717	14283	00112	14395	53
8	85780	99887	85893	14107	00113	14220	52
9	85955	99886	86060	13931	00114	14045	51
10	8.86128	9.99885	8.86243	11.13757	10.00115	11.13872	50
11	86301	99884	86417	13583	00116	13699	49
12	86474	99883	86590	13409	00117	13520	48
13	86645	99882	86763	13237	00118	13355	47
14	86816	99881	86935	13065	00119	13183	46
15	86987	99880	87106	12894	00120	13013	45
16	87156	99879	87277	12723	00120	12843	44
17	87325	99878	87447	12553	00121	12674	43
18	87494	99878	87616	12384	00122	12505	42
19	87661	99877	87785	12215	00123	12338	41
20	8.87829	9.99876	8.87953	11.12047	10.00124	11.12171	40
21	87995	99875	88120	11880	00125	12005	39
22	88161	99874	88287	11713	00126	11839	38
23	88326	99873	88433	11547	00127	11674	37
24	88490	99872	88618	11381	00128	11500	36
25	88654	99871	88783	11217	00129	11346	35
26	88817	99870	88948	11052	00130	11183	34
27	88980	99869	89111	10889	00131	11020	33
28	89142	99868	89274	10726	00132	10858	32
29	89304	99867	89427	10563	00133	10696	31
30	8.89464	9.99866	8.89598	11.10402	10.00134	11.10536	30
31	89624	99865	89760	10240	00135	10375	29
32	89784	99864	89920	10080	00136	10216	28
33	89943	99863	90080	9920	00137	10057	27
34	90102	99862	90240	9760	00138	99398	26
35	90260	99861	90399	9601	00139	99740	25
36	90417	99860	90557	9443	00140	99583	24
37	90574	99859	90715	9285	00141	99426	23
38	90730	99858	90872	9128	00142	99270	22
39	90885	99857	91028	8971	00143	99115	21
40	8.91040	9.99856	8.91185	11.08815	10.00144	11.08960	20
41	91195	99855	91340	8860	00145	8805	19
42	91349	99854	91495	8705	00146	8651	18
43	91502	99853	91649	8550	00147	8498	17
44	91655	99852	91803	8397	00148	8345	16
45	91807	99851	91957	8243	00149	8193	15
46	91959	99849	92110	8090	00150	8041	14
47	92110	99848	92262	7938	00151	7890	13
48	92261	99847	92514	7786	00153	7739	12
49	92411	99846	92565	7635	00154	7589	11
50	8.92561	9.99845	8.92716	11.07284	10.00155	11.07439	10
51	92710	99844	92866	7484	00156	7439	9
52	92859	99843	93015	7334	00157	7290	8
53	93007	99842	93165	7184	00158	7141	7
54	93154	99841	93313	7035	00159	7093	6
55	93301	99840	93462	6887	00160	6946	5
56	93448	99839	93609	6739	00161	6852	4
57	93594	99838	93756	6591	00162	6706	3
58	93740	99837	93903	6443	00163	6660	2
59	93885	99835	94049	6295	00164	6615	1
60	94030	99834	94195	6147	00166	6570	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

85 Degrees.

A-Table of Artificial Sines, Tang. and Sec. 5 Degrees.

M.	Sine.	Co fine	Tang.	Co-tang.	Secant.	Co secant	
0	8.94030	9.99834	8.94195	11.05805	10.00166	11.05670	60
1	94174	99833	94340	05660	00167	05826	59
2	94317	99832	94485	05515	00168	05683	58
3	94461	99831	94629	05370	00169	05539	57
4	94603	99830	94773	05227	00170	05397	56
5	94746	99829	94917	05083	00171	05254	55
6	94887	99828	95060	04940	00172	05113	54
7	95029	99827	95202	04798	00173	04971	53
8	95170	99825	95344	04656	00174	04830	52
9	95310	99824	95486	04514	00175	04690	51
10	8.95450	9.99823	8.95627	11.04373	10.00177	11.04550	50
11	95590	99822	95767	04233	00178	04411	49
12	95728	99821	95907	04092	00179	04272	48
13	95867	99820	96047	03953	00180	04133	47
14	96005	99819	96187	03813	00181	03995	46
15	96143	99817	96325	03675	00183	03857	45
16	96280	99816	96464	03536	00184	03720	44
17	96417	99815	96602	03398	00185	03583	43
18	96553	99814	96739	03261	00186	03447	42
19	96689	99813	96877	03123	00187	03311	41
20	8.96825	9.99812	8.97013	11.02987	10.00188	11.03175	40
21	96960	99810	97150	02850	00190	03040	39
22	97095	99809	97285	02714	00191	02905	38
23	97229	99808	97421	02579	00192	02771	37
24	97363	99807	97556	02444	00193	02637	36
25	97496	99806	97691	02309	00194	02504	35
26	97629	99804	97825	02175	00196	02371	34
27	97762	99803	97959	02041	00197	02238	33
28	97894	99802	98092	01908	00198	02106	32
29	98026	99801	98225	01775	00199	01974	31
30	8.98157	9.99800	8.98358	11.01642	10.00200	11.01843	30
31	98288	99798	98490	01510	00202	01712	29
32	98419	99797	98622	01378	00203	01581	28
33	98549	99796	98753	01247	00204	01450	27
34	98679	99795	98884	01116	00205	01321	26
35	98808	99793	99015	00985	00206	01192	25
36	98937	99792	99145	00855	00208	01063	24
37	99066	99791	99275	00725	00209	00934	23
38	99194	99790	99405	00595	00210	00806	22
39	99322	99788	99534	00466	00211	00678	21
40	8.99450	9.99787	8.99662	11.00438	10.00213	11.00550	20
41	99577	99786	99791	00209	00214	00423	19
42	9 704	99785	99919	00081	00215	00296	18
43	99830	99783	9.00046	10.99954	00216	00170	17
44	99956	99782	00174	99826	00218	00044	16
45	9.00082	99781	00301	99699	00219	10.99918	15
46	00207	99780	00427	99573	00220	99793	14
47	00332	99779	00553	99447	00222	99668	13
48	00456	99777	00679	99321	00223	99544	12
49	00580	99776	00805	99195	00224	99419	11
50	9.00704	9.99774	9.00930	10.99070	10.00225	10.99296	10
51	00828	99773	01055	98945	00227	99172	9
52	00951	99772	01179	98821	00228	99049	8
53	01074	99771	01303	98697	00229	98926	7
54	01196	99769	01427	98573	00231	98804	6
55	01318	99768	01550	98450	00232	98682	5
56	01440	99767	01673	98327	00233	98560	4
57	01561	99765	01706	98204	00234	98438	3
58	01682	99764	01918	98082	00236	98318	2
59	01803	99763	02040	97960	00237	98197	1
60	01925	99761	02162	97838	00239	98077	0
Co-fine.	Sine.	Co tang.	Tangent.	Co-secant.	Secant.	M.	

84 Degrees

A Table of Artificial Sines, Tang. and Sec. 6 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9.01923	9.99761	9.02162	10.97838	10.00239	10.98076	60
1	02043	99760	02283	97717	00240	97956	59
2	02163	99759	02404	97596	00251	97837	58
3	02283	99757	02525	97475	00243	97717	57
4	02402	99756	02645	97354	00244	97598	56
5	02520	99755	02765	97234	00245	97480	55
6	02639	99753	02885	97115	00247	97361	54
7	02757	99752	03005	96995	00248	97243	53
8	02874	99751	03124	96876	00249	97126	52
9	02992	99749	03242	96757	00251	97008	51
10	9.03109	9.99748	9.03361	10.96639	10.00252	10.96891	50
11	03226	99747	03479	96521	00253	96774	49
12	03342	99745	03597	96403	00255	96658	48
13	03458	99744	03714	96286	00256	96542	47
14	03574	99742	03832	96168	00257	96426	46
15	03690	99741	03948	96051	00259	96310	45
16	03805	99740	04065	95935	00260	96195	44
17	03920	99738	04181	95819	00262	96080	43
18	04034	99737	04297	95703	00263	95966	42
19	04149	99735	04413	95587	00264	95851	41
20	9.04262	9.99734	9.04528	10.95472	10.00266	10.95737	40
21	04376	99733	04643	95357	00267	95624	39
22	04489	99731	04758	95242	00269	95510	38
23	04603	99730	04873	95127	00270	95397	37
24	04715	99728	04987	95013	00271	95285	36
25	04828	99727	05101	94899	00273	95172	35
26	04940	99726	05214	94786	00274	95060	34
27	05052	99724	05328	94672	00276	94948	33
28	05164	99723	05441	94559	00277	94836	32
29	05275	99721	05553	94447	00279	94725	31
30	9.05386	9.99720	9.05666	10.94334	10.00280	10.94614	30
31	05497	99718	05778	94222	00281	94503	29
32	05607	99717	05890	94110	00283	94393	28
33	05717	99716	06002	93998	00284	94283	27
34	05827	99714	06113	93887	00286	94173	26
35	05937	99713	06224	93776	00287	94063	25
36	06046	99711	06335	93665	00289	93954	24
37	06155	99710	06445	93555	00290	93845	23
38	06264	99708	06556	93444	00292	93736	22
39	06372	99707	06665	93334	00293	93628	21
40	9.06481	9.99705	9.06775	10.93225	10.00295	10.93519	20
41	06588	99704	06885	93115	00296	93411	19
42	06696	99702	06994	93006	00298	93304	18
43	06804	99701	07103	92897	00299	93196	17
44	06911	99699	07211	92789	00301	93089	16
45	07018	99698	07320	92680	00302	92982	15
46	07124	99696	07428	92572	00304	92876	14
47	07231	99695	07536	92464	00305	92769	13
48	07337	99693	07643	92357	00307	92663	12
49	07442	99692	07750	92249	00308	92558	11
50	9.07548	9.99690	9.07858	10.92142	10.00310	10.92452	10
51	07653	99689	07964	92036	00311	92347	9
52	07758	99687	08071	91929	00313	92242	8
53	07863	99686	08177	91823	00314	92137	7
54	07968	99684	08283	91717	00316	92032	6
55	08072	99683	08389	91611	00317	91928	5
56	08176	99681	08495	91505	00319	91824	4
57	08280	99680	08601	91400	00320	91720	3
58	08383	99678	08705	91295	00322	91617	2
59	08486	99677	08810	91190	00323	91514	1
60	08580	99675	08914	91086	00325	91411	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 7 Degrees.

M.	Sine.	Co-fine.	Tangent	Co-tang.	Secant.	Co-secant	
0	9.08589	9.99675	9.08914	10.91086	10.00325	10.91411	60
1	08692	99673	09019	90981	00326	91308	59
2	08795	99672	09123	90877	00328	91205	58
3	08897	99670	09227	90773	00330	91103	57
4	08999	99669	09330	90670	00331	91001	56
5	09101	99667	09434	90566	00333	90899	55
6	09202	99666	09537	90463	00334	90798	54
7	09304	99664	09640	90360	00336	90696	53
8	09405	99662	09742	90258	00337	90595	52
9	09506	99661	09845	90155	00339	90494	51
10	9.09606	9.99659	9.09947	10.90053	10.00341	10.90394	50
11	09706	99658	10049	89951	00342	90293	49
12	09807	99656	10150	89850	00344	90193	48
13	09906	99655	10252	89748	00345	90093	47
14	10006	99653	10353	89647	00347	89994	46
15	10106	99651	10454	89546	00349	89894	45
16	10205	99650	10555	89445	00350	89795	44
17	10304	99648	10656	89344	00352	89696	43
18	10402	99647	10756	89244	00353	89597	42
19	10501	99645	10856	89144	00355	89499	41
20	9.10599	9.99643	9.11956	10.89044	10.00357	10.89401	40
21	10697	99642	11056	88944	00358	89303	39
22	10795	99640	11155	88845	00360	89205	38
23	10893	99638	11254	88746	00362	89107	37
24	10990	99637	11353	88647	00363	89010	36
25	11087	99635	11452	88548	00365	88913	35
26	11184	99633	11551	88449	00366	88816	34
27	11281	99632	11649	88351	00368	88719	33
28	11377	99630	11747	88253	00370	88623	32
29	11474	99628	11845	88155	00371	88526	31
30	9.11570	9.99627	9.11943	10.88057	10.00373	10.88430	30
31	11666	99625	12040	87960	00375	88334	29
32	11761	99623	12138	87862	00376	88239	28
33	11857	99622	12235	87765	00378	88143	27
34	11952	99620	12332	87668	00380	88048	26
35	12047	99618	12428	87572	00381	87953	25
36	12142	99617	12525	87475	00383	87858	24
37	12236	99615	12621	87379	00385	87764	23
38	12331	99613	12717	87283	00387	87669	22
39	12425	99612	12813	87187	00388	87575	21
40	9.12519	9.99610	9.12909	10.87091	10.00390	10.87481	20
41	12612	99608	13004	86996	00392	87387	19
42	12706	99607	13099	86901	00393	87294	18
43	12799	99605	13194	86806	00395	87201	17
44	12892	99603	13289	86711	00397	87107	16
45	12985	99601	13384	86616	00398	87015	15
46	13078	99600	13478	86522	00400	86922	14
47	13171	99598	13573	86427	00402	86829	13
48	13263	99596	13667	86333	00404	86737	12
49	13355	99595	13760	86239	00405	86645	11
50	9.13447	9.99593	9.13854	10.86146	10.00407	10.86553	10
51	13539	99591	13948	86052	00409	86461	9
52	13630	99589	14041	85959	00411	86370	8
53	13722	99588	14134	85866	00412	86278	7
54	13813	99586	14227	85773	00414	86187	6
55	13904	99584	14320	85680	00416	86096	5
56	13994	99582	14412	85588	00418	86006	4
57	14085	99581	14504	85496	00419	85915	3
58	14175	99579	14596	85403	00421	85825	2
59	14266	99577	14688	85311	00423	85734	1
60	14356	99575	14780	85200	00425	85644	0
	Co-fine.	Sine	Co-tang.	Tangent.	Co-secant.	Secant.	M.

82 Degrees.

A Table of Artificial Sines, Tang. and Sec. 8 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.14356	9.99575	9.14780	10.85220	10.00425	10.85644	60
1	14445	99573	14872	85128	00426	85555	59
2	14535	99572	14963	85037	00428	85465	58
3	14624	99570	15054	84946	00430	85376	57
4	14714	99568	15145	84855	00432	85286	56
5	14803	99566	15236	84764	00434	85197	55
6	14891	99565	15327	84673	00435	85108	54
7	14980	99563	15417	84583	00437	85020	53
8	15069	99561	15508	84492	00439	84931	52
9	15157	99559	15598	84402	00441	84843	51
10	9.15245	9.99557	9.15688	10.84312	10.00443	10.84755	50
11	15333	99555	15777	84222	00444	84667	49
12	15421	99554	15867	84133	00446	84579	48
13	15508	99552	15956	84043	00448	84492	47
14	15596	99550	16046	83954	00450	84404	46
15	15683	99548	16135	83865	00452	84317	45
16	15770	99546	16224	83776	00454	84230	44
17	15857	99545	16312	83688	00455	84143	43
18	15943	99543	16401	83599	00457	84056	42
19	16030	99541	16489	83501	00459	83970	41
20	9.16116	9.99539	9.16577	10.83423	10.00461	10.83884	40
21	16203	99537	16665	83335	00463	83797	39
22	16289	99535	16753	83247	00465	83711	38
23	16374	99533	16841	83159	00467	83626	37
24	16460	99532	16928	83072	00468	83540	36
25	16545	99530	17016	82984	00470	83455	35
26	16631	99528	17103	82897	00472	83369	34
27	16716	99526	17190	82810	00474	83284	33
28	16801	99524	17277	82723	00476	83199	32
29	16886	99522	17363	82637	00478	83114	31
30	9.16970	9.99520	9.17450	10.82550	10.00480	10.83030	30
31	17055	99518	17536	82464	00482	82945	29
32	17139	99517	17622	82378	00483	82861	28
33	17223	99515	17708	82292	00485	82777	27
34	17307	99513	17794	82206	00487	82693	26
35	17391	99511	17880	82120	00489	82609	25
36	17474	99509	17965	82034	00491	82526	24
37	17558	99507	18051	81949	00493	82442	23
38	17641	99505	18136	81864	00495	82359	22
39	17724	99503	18221	81779	00497	82276	21
40	9.17807	9.99501	9.18306	10.81694	10.00499	10.82193	20
41	17890	99499	18391	81609	00501	82110	19
42	17973	99497	18475	81525	00503	82027	18
43	18055	99495	18560	81440	00504	81945	17
44	18137	99493	18644	81356	00506	81863	16
45	18220	99492	18728	81272	00508	81782	15
46	18302	99490	18812	81188	00510	81698	14
47	18383	99488	18896	81104	00512	81617	13
48	18465	99486	18979	81021	00514	81535	12
49	18547	99484	19063	80937	00516	81453	11
50	9.18628	9.99482	9.19146	10.80854	10.00518	10.81372	10
51	18709	99480	19229	80771	00520	81291	9
52	18790	99478	19312	80688	00522	81210	8
53	18871	99476	19395	80605	00524	81129	7
54	18952	99474	19478	80522	00526	81048	6
55	19033	99472	19561	80436	00528	80967	5
56	19113	99470	19643	80357	00530	80887	4
57	19193	99468	19725	80275	00532	80807	3
58	19273	99466	19807	80193	00534	80727	2
59	19353	99464	19889	80111	00536	80647	1
60	19433	99462	19971	80029	00538	80567	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 9 Degrees.

M.	Sine.	Co-line.	Tangent.	Co-tang.	Secant.	Co-secant.	
0	9. 19433	9. 99462	9. 19971	10. 80029	10. 00538	10. 80567	60
1	19513	99450	20053	79947	00540	80487	59
2	19592	99438	20134	79865	00542	80408	58
3	19672	99426	20216	79784	00544	80328	57
4	19751	99414	20297	79703	00546	80249	56
5	19830	99402	20378	79621	00548	80170	55
6	19909	99390	20459	79541	00550	80091	54
7	19988	99378	20540	79460	00552	80012	53
8	20067	99366	20621	79379	00554	79933	52
9	20145	99354	20701	79299	00556	79855	51
10	9. 20223	9. 99442	9. 20782	10. 79218	10. 00558	10. 79777	50
11	20302	99430	20862	79138	00560	79698	49
12	20380	99418	20942	79058	00562	79620	48
13	20458	99406	21021	78978	00564	79542	47
14	20535	99394	21102	78898	00566	79465	46
15	20613	99382	21181	78818	00568	79387	45
16	20691	99370	21261	78739	00570	79309	44
17	20768	99358	21340	78659	00573	79232	43
18	20845	99346	21420	78580	00575	79155	42
19	20922	99334	21499	78501	00577	79078	41
20	9. 20999	9. 99421	9. 21578	10. 78422	10. 00579	10. 79001	40
21	21076	99419	21657	78343	00581	78924	39
22	21153	99417	21736	78264	00583	78847	38
23	21229	99415	21814	78186	00585	78771	37
24	21305	99413	21893	78107	00587	78694	36
25	21382	99411	21971	78029	00589	78618	35
26	21458	99409	22049	77951	00591	78542	34
27	21534	99407	22127	77873	00593	78465	33
28	21610	99404	22205	77795	00595	78390	32
29	21685	99402	22283	77717	00598	78315	31
30	9. 21761	9. 99400	9. 22361	10. 77639	10. 00600	10. 78239	30
31	21836	99398	22438	77562	00602	78164	29
32	21912	99396	22516	77484	00604	78088	28
33	21987	99394	22593	77407	00606	78013	27
34	22062	99392	22670	77330	00608	77938	26
35	22137	99390	22747	77253	00610	77863	25
36	22211	99388	22824	77177	00612	77788	24
37	22286	99385	22901	77099	00615	77714	23
38	22361	99383	22977	77022	00617	77639	22
39	22435	99381	23054	76946	00619	77565	21
40	9. 22509	9. 99379	9. 23130	10. 76870	10. 00621	10. 77491	20
41	22583	99377	23206	76793	00623	77417	19
42	22657	99375	23283	76717	00625	77343	18
43	22731	99373	23355	76641	00628	77269	17
44	22805	99370	23435	76565	00630	77195	16
45	22878	99368	23510	76490	00632	77122	15
46	22952	99366	23586	76414	00634	77048	14
47	23025	99364	23661	76339	00636	76975	13
48	23098	99362	23737	76263	00638	76902	12
49	23171	99359	23812	76188	00641	76829	11
50	9. 23244	9. 99357	9. 23887	10. 76113	10. 00643	10. 76756	10
51	23317	99355	23962	76038	00645	76683	9
52	23390	99353	24037	75963	00647	76610	8
53	23462	99351	24112	75888	00649	76538	7
54	23535	99348	24186	75813	00652	76465	6
55	23607	99346	24261	75739	00654	76393	5
56	23679	99344	24335	75665	00656	76321	4
57	23751	99342	24410	75590	00658	76248	3
58	23823	99340	24484	75516	00660	76177	2
59	23895	99337	24558	75442	00663	76105	1
60	23967	99335	24633	75368	00665	76033	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

80 Degrees.

A Table of Artificial Sines, Tang. and Sec. 10 Degrees.

M.	Sine.	Co-fine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.23967	9.99335	9.24632	10.75368	10.00665	10.76033	60
1	24039	99333	24706	75294	00667	75961	59
2	24110	99331	24779	75221	00669	75890	58
3	24181	99328	24853	75147	00672	75819	57
4	24253	99326	24926	75074	00674	75747	56
5	24324	99324	25000	75000	00676	75676	55
6	24395	99322	25073	74927	00678	75605	54
7	24466	99319	25146	74854	00680	75534	53
8	24536	99317	25219	74781	00683	75464	52
9	24607	99315	25292	74708	00685	75393	51
10	9.24677	9.99313	9.25305	10.74635	10.00687	10.75323	50
11	24748	99310	25437	74563	00690	75252	49
12	24818	99308	25510	74490	00692	75182	48
13	24888	99306	25582	74418	00694	75112	47
14	24958	99304	25655	74345	00696	75042	46
15	25028	99301	25727	74273	00699	74972	45
16	25098	99299	25799	74201	00701	74902	44
17	25168	99297	25871	74129	00703	74832	43
18	25237	99294	25943	74057	00706	74762	42
19	25307	99292	26015	73985	00708	74693	41
20	9.25370	9.99290	9.26086	10.73914	10.00710	10.74623	40
21	25445	99288	26158	73842	00712	74555	39
22	25514	99285	26229	73771	00715	74486	38
23	25583	99283	26301	73699	00717	74417	37
24	25652	99281	26372	73628	00719	74348	36
25	25721	99278	26443	73557	00722	74279	35
26	25790	99276	26514	73486	00724	74210	34
27	25858	99274	26585	73415	00726	74142	33
28	25927	99271	26655	73344	00729	74073	32
29	25995	99269	26726	73274	00731	74005	31
30	9.26063	9.99267	9.26797	10.73203	10.00733	10.73937	30
31	26131	99264	26867	73133	00736	73869	29
32	26199	99262	26937	73063	00738	73801	28
33	26267	99260	27008	72992	00741	73733	27
34	26335	99257	27078	72922	00743	73665	26
35	26403	99255	27148	72852	00745	73597	25
36	26470	99252	27218	72782	00747	73530	24
37	26538	99250	27288	72712	00750	73462	23
38	26605	99248	27357	72643	00752	73395	22
39	26672	99245	27427	72573	00755	73328	21
40	9.26739	9.99243	9.27496	10.72504	10.00757	10.73261	20
41	26806	99241	27566	72434	00759	73193	19
42	26873	99238	27635	72365	00762	73127	18
43	26940	99236	27704	72296	00764	73060	17
44	27007	99233	27773	72227	00766	72993	16
45	27073	99231	27842	72158	00769	72927	15
46	27140	99229	27911	72089	00771	72860	14
47	27206	99226	27980	72020	00774	72794	13
48	27273	99224	28049	71951	00776	72727	12
49	27339	99221	28117	71883	00779	72661	11
50	9.27405	9.99219	9.28186	10.71814	10.00781	10.72595	10
51	27471	99217	28254	71746	00783	72529	9
52	27537	99214	28323	71677	00786	72463	8
53	27602	99212	28391	71609	00788	72398	7
54	27668	99209	28459	71541	00791	72332	6
55	27734	99207	28527	71473	00793	72266	5
56	27799	99204	28595	71405	00796	72201	4
57	27864	99202	28662	71338	00798	72136	3
58	27930	99200	28730	71270	00800	72070	2
59	27995	99197	28798	71202	00803	72005	1
60	28060	99195	28865	71135	00805	71940	0
	Co-fine.	Sine.	o-tang	Tang nt.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 11 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.28060	9.99195	9.28865	10.71135	10.00805	10.71940	60
1	28125	99192	28933	71067	00808	71875	59
2	28190	99190	29000	71000	00810	71810	58
3	28254	99187	29067	70933	00813	71746	57
4	28319	99185	29134	70866	00815	71681	56
5	28384	99182	29201	70799	00818	71616	55
6	28448	99180	29268	70732	00820	71552	54
7	28512	99177	29335	70665	00823	71488	53
8	28577	99175	29402	70598	00825	71423	52
9	28641	99172	29468	70532	00828	71359	51
10	9.28705	9.99170	9.29535	10.70465	10.00830	10.71295	50
11	28769	99167	29601	70399	00833	71231	49
12	28833	99165	29668	70332	00835	71167	48
13	28896	99162	29734	70266	00838	71104	47
14	28960	99160	29800	70200	00840	71040	46
15	29024	99157	29866	70134	00843	70975	45
16	29087	99155	29932	70068	00845	70913	44
17	29150	99152	29998	70002	00848	70850	43
18	29214	99150	30064	69936	00850	70786	42
19	29277	99147	30130	69870	00853	70723	41
20	9.29340	9.99145	9.30195	10.69805	10.00855	10.70660	40
21	29403	99142	30261	69739	00858	70597	39
22	29466	99140	30326	69674	00860	70534	38
23	29529	99137	30391	69609	00863	70471	37
24	29591	99135	30457	69543	00865	70409	36
25	29654	99132	30522	69478	00868	70346	35
26	29716	99130	30587	69413	00870	70284	34
27	29779	99127	30652	69348	00873	70221	33
28	29841	99124	30717	69283	00876	70159	32
29	29903	99122	30782	69218	00878	70097	31
30	9.29966	9.99119	9.30846	10.69154	10.00881	10.70034	30
31	30028	99117	30911	69189	00883	69972	29
32	30090	99114	30975	69125	00886	69910	28
33	30151	99112	31040	69060	00888	69849	27
34	30213	99109	31104	68996	00891	69787	26
35	30275	99106	31168	68931	00894	69725	25
36	30336	99104	31233	68867	00896	69664	24
37	30398	99101	31297	68803	00899	69602	23
38	30459	99099	31361	68739	00901	69541	22
39	30521	99096	31424	68675	00904	69479	21
40	9.30582	9.99093	9.31489	10.68511	10.00907	10.69418	20
41	30643	99091	31552	68448	00909	69357	19
42	30704	99088	31616	68384	00912	69296	18
43	30765	99086	31679	68320	00914	69235	17
44	30826	99083	31743	68257	00917	69174	16
45	30887	99080	31806	68194	00920	69113	15
46	30947	99078	31870	68130	00922	69053	14
47	31008	99075	31933	68067	00925	68992	13
48	31068	99072	31996	68004	00928	68931	12
49	31129	99070	32059	67941	00930	68871	11
50	9.31189	9.99067	9.32122	10.67878	10.00933	10.68811	10
51	31249	99064	32185	67815	00936	68750	9
52	31310	99062	32148	67752	00938	68690	8
53	31370	99059	32311	67689	00941	68630	7
54	31430	99056	32373	67627	00944	68570	6
55	31490	99054	32436	67564	00946	68510	5
56	31549	99051	32498	67502	00949	68451	4
57	31609	99048	32561	67439	00952	68391	3
58	31669	99046	32623	67377	00954	68331	2
59	31728	99043	32685	67315	00957	68272	1
60	31788	99040	32747	67252	00960	68212	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 12 Degrees.

M.	Sine.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.31788	9.99040	9.32747	10.67253	10.00960	10.68212	60
1	31847	99038	32810	67190	00962	68153	59
2	31907	99035	32872	67128	00965	68093	58
3	31966	99032	32933	67067	00968	68034	57
4	32025	99030	32995	67005	00970	67975	56
5	32084	99027	33057	66943	00973	67916	55
6	32143	99024	33119	66881	00976	67857	54
7	32202	99022	33180	66820	00978	67798	53
8	32261	99019	33242	66758	00981	67739	52
9	32319	99016	33303	66697	00984	67681	51
10	9.32378	9.99013	9.33365	10.66635	10.00987	10.67622	50
11	32437	99011	33426	66574	00989	67563	49
12	32495	99008	33487	66513	00992	67505	48
13	32553	99005	33548	66452	00995	67447	47
14	32612	99002	33609	66391	00998	67388	46
15	32670	99000	33670	66330	01000	67330	45
16	32728	98997	33731	66269	01003	67272	44
17	32786	98994	33792	66208	01006	67214	43
18	32844	98991	33853	66147	01009	67156	42
19	32902	98989	33913	66087	01011	67098	41
20	9.32960	9.98986	9.33974	10.66026	10.01014	10.67040	40
21	33018	98983	34034	65966	01017	66982	39
22	33075	98980	34095	65905	01020	66925	38
23	33133	98978	34155	65845	01022	66867	37
24	33190	98975	34215	65784	01025	66810	36
25	33248	98972	34276	65724	01028	66752	35
26	33305	98969	34336	65664	01031	66695	34
27	33362	98967	34396	65604	01033	66638	33
28	33420	98964	34456	65544	01036	66580	32
29	33477	98961	34516	65484	01039	66523	31
30	9.33534	9.98958	9.34576	10.65424	10.01042	10.66466	30
31	33591	98955	34635	65365	01045	66409	29
32	33647	98953	34695	65305	01047	66352	28
33	33704	98950	34755	65245	01050	66296	27
34	33761	98947	34814	65186	01053	66239	26
35	33818	98944	34874	65126	01056	66182	25
36	33874	98941	34933	65067	01059	66126	24
37	33931	98938	34992	65008	01062	66069	23
38	33987	98936	35051	64949	01064	66013	22
39	34043	98933	35111	64889	01067	65957	21
40	9.34100	9.98930	9.35170	10.64830	10.01070	10.65900	20
41	34156	98927	35229	64771	01073	65844	19
42	34212	98924	35288	64712	01076	65788	18
43	34268	98921	35346	64653	01079	65732	17
44	34324	98919	35405	64595	01081	65676	16
45	34380	98916	35464	64536	01084	65620	15
46	34435	98913	35523	64478	01087	65564	14
47	34491	98910	35581	64419	01090	65509	13
48	34547	98907	35640	64360	01093	65453	12
49	34602	98904	35698	64302	01096	65398	11
50	9.34658	9.98901	9.35757	10.64243	10.01099	10.65342	10
51	34713	98898	35815	64185	01102	65287	9
52	34769	98896	35873	64127	01104	65231	8
53	34824	98893	35931	64069	01107	65176	7
54	34879	98890	35989	64011	01110	65121	6
55	34934	98887	36047	63953	01113	65066	5
56	34989	98884	36105	63895	01116	65011	4
57	35044	98881	36163	63837	01119	64956	3
58	35099	98878	36221	63779	01122	64901	2
59	35154	98875	36279	63721	01125	64846	1
60	35209	98872	36336	63664	01128	64791	0
	Co-line.	Sine.	Co tang.	Tang.	Co-secant	Secant.	M

.. 77 Degrees.

A Table of Artificial Sines, Tang. and Sec. 13 Degrees.

M.	Sine.	Co-line.	Tangent	Co-tang.	Secant.	Co-secant.	
0	9.35209	9.98872	9.36336	10.63664	10.01128	10.64791	60
1	35263	98869	36394	63606	01130	64736	59
2	35318	98867	36451	63548	01133	64682	58
3	35373	98864	36509	63491	01136	64627	57
4	35427	98861	36566	63434	01139	64573	56
5	35481	98858	36624	63376	01142	64518	55
6	35536	98855	36681	63319	01145	64464	54
7	35590	98852	36738	63262	01147	64410	53
8	35644	98849	36795	63205	01151	64356	52
9	35698	98846	36852	63148	01154	64302	51
10	9.35752	9.98843	9.36909	10.63091	10.01157	10.64248	50
11	35806	98840	36966	63034	01160	64194	49
12	35860	98837	37023	62977	01163	64140	48
13	35914	98834	37080	62920	01166	64086	47
14	35968	98831	37137	62863	01169	64032	46
15	36021	98828	37193	62807	01172	63978	45
16	36075	98825	37250	62750	01175	63923	44
17	36129	98822	37306	62694	01178	63871	43
18	36182	98819	37363	62637	01181	63818	42
19	36236	98816	37419	62581	01184	63764	41
20	9.36289	9.98813	9.37476	10.62524	10.01187	10.63711	40
21	36342	98810	37532	62468	01190	63658	39
22	36395	98807	37588	62412	01193	63605	38
23	36448	98804	37644	62356	01196	63551	37
24	36502	98801	37700	62300	01199	63498	36
25	36555	98798	37756	62244	01202	63445	35
26	36607	98795	37812	62188	01205	63392	34
27	36660	98792	37869	62132	01208	63340	33
28	36713	98789	37924	62076	01211	63287	32
29	36766	98786	37980	62020	01214	63234	31
30	9.36818	9.98783	9.38035	10.61965	10.01217	10.63181	30
31	36871	98780	38091	61909	01220	63129	29
32	36924	98777	38147	61853	01223	63076	28
33	36976	98774	38202	61798	01226	63024	27
34	37028	98771	38257	61742	01229	62971	26
35	37081	98768	38313	61687	01231	62919	25
36	37133	98765	38368	61632	01235	62867	24
37	37185	98762	38423	61577	01238	62815	23
38	37237	98759	38479	61521	01241	62763	22
39	37289	98756	38534	61466	01244	62711	21
40	9.37341	9.98753	9.38589	10.61411	10.01247	10.62659	20
41	37393	98749	38644	61356	01250	62607	19
42	37445	98746	38699	61301	01254	62555	18
43	37497	98743	38754	61246	01257	62503	17
44	37549	98740	38808	61192	01260	62451	16
45	37600	98737	38863	61137	01263	62400	15
46	37652	98734	38918	61082	01266	62348	14
47	37703	98731	38972	61028	01269	62296	13
48	37755	98728	39027	60973	01272	62245	12
49	37806	98725	39081	60918	01275	62194	11
50	9.37858	9.98722	9.39136	10.60864	10.01278	10.62142	10
51	37909	98719	39190	60810	01281	62091	9
52	37960	98715	39245	60755	01285	62040	8
53	38011	98712	39299	60701	01288	61989	7
54	38062	98709	39353	60647	01291	61938	6
55	38113	98706	39407	60593	01294	61887	5
56	38164	98703	39461	60539	01297	61836	4
57	38215	98700	39515	60485	01300	61785	3
58	38266	98697	39569	60431	01303	61734	2
59	38317	98694	39623	60377	01306	61683	1
60	38368	98690	39677	60323	01310	61632	0
	n-line.	Sine.	Co tang	Tangent.	Co-secant.	Secant.	M.

76 Degrees.

A Table of Artificial Sines. Tang. and Sec. 14 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.38368	9.98690	9.39677	10.60323	10.01310	10.61632	60
1	38418	98687	39731	60269	01313	61582	59
2	38469	98684	39781	60215	01316	61531	58
3	38519	98681	39831	60162	01319	61481	57
4	38570	98678	39892	60108	01322	61430	56
5	38620	98675	39945	60054	01325	61380	55
6	38670	98671	39999	60001	01329	61330	54
7	38721	98668	40052	59948	01332	61280	53
8	38771	98665	40106	59894	01335	61229	52
9	38821	98662	40159	59841	01338	61179	51
10	9.38871	9.98659	9.40212	10.59788	10.01341	10.61129	50
11	38921	98655	40266	59734	01344	61079	49
12	38971	98652	40319	59681	01348	61029	48
13	39021	98649	40372	59628	01351	60979	47
14	39071	98646	40425	59575	01354	60929	46
15	39121	98643	40478	59522	01357	60879	45
16	39170	98640	40531	59469	01360	60830	44
17	39220	98636	40584	59416	01364	61780	43
18	39270	98633	40636	59363	01367	60730	42
19	39319	98630	40689	59311	01371	60681	41
20	9.39369	9.98627	9.40742	10.59258	10.01373	10.60631	40
21	39418	98623	40795	59205	01377	60582	39
22	39467	98620	40847	59153	01380	60533	38
23	39517	98617	40900	59100	01383	60483	37
24	39566	98614	40952	59048	01386	60434	36
25	39615	98610	41004	58995	01390	60385	35
26	39664	98607	41057	58943	01393	60336	34
27	39713	98604	41109	58891	01396	60287	33
28	39762	98601	41161	58839	01399	60238	32
29	39811	98594	41214	58786	01402	60189	31
30	9.39860	9.98594	9.41266	10.58734	10.01406	10.60140	30
31	39909	98591	41318	58682	01409	60091	29
32	39957	98588	41370	58630	01412	60042	28
33	40006	98584	41422	58578	01416	59994	27
34	40055	98581	41474	58526	01419	59945	26
35	40103	98578	41526	58474	01422	59896	25
36	40152	98574	41577	58422	01426	59848	24
37	40200	98571	41629	58371	01429	59800	23
38	40249	98568	41681	58319	01432	59751	22
39	40297	98565	41732	58267	01435	59703	21
40	9.40345	9.98561	9.41784	10.58216	10.01439	10.59654	20
41	40394	98558	41836	58164	01442	59606	19
42	40442	98555	41887	58113	01445	59558	18
43	40490	98551	41939	58061	01449	59510	17
44	40538	98548	41990	58010	01452	59462	16
45	40586	98545	42041	57958	01455	59414	15
46	40634	98541	42093	57907	01459	59366	14
47	40682	98538	42144	57856	01462	59318	13
48	40730	98535	42195	57805	01465	59270	12
49	40778	98531	42246	57754	01469	59222	11
50	9.40825	9.98528	9.42297	10.57703	10.01472	10.59175	10
51	40873	98525	42348	57652	01475	59127	9
52	40921	98521	42399	57601	01479	59079	8
53	40968	98518	42450	57550	01482	59032	7
54	41016	98515	42501	57499	01485	58984	6
55	41063	98511	42552	57448	01489	58937	5
56	41111	98508	42603	57397	01492	58889	4
57	41158	98504	42653	57347	01495	58845	3
58	41205	98501	42704	57296	01499	58795	2
59	41252	98498	42755	57245	01502	58748	1
60	41300	98494	42805	57195	01506	58700	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

75 Degrees.

A Table of Artificial Sines, Tang. and Sec. 15 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.41300	9.98494	9.42805	10.57195	10.01506	10.58700	60
1	41347	98491	42856	57144	01508	58653	59
2	41394	98488	42906	57094	01512	58606	58
3	41441	98484	42957	57043	01516	58559	57
4	41488	98481	43007	56993	01519	58512	56
5	41535	98477	43057	56943	01523	58465	55
6	41582	98474	43108	56892	01526	58418	54
7	41628	98471	43158	56842	01529	58372	53
8	41675	98467	43208	56792	01533	58325	52
9	41722	98464	43258	56744	01536	58278	51
10	9.41768	9.98460	9.43308	10.56692	10.01540	10.58232	50
11	41815	98457	43358	56642	01543	58185	49
12	41861	98453	43408	56592	01547	58138	48
13	41908	98450	43458	56542	01550	58092	47
14	41954	98447	43508	56492	01553	58046	46
15	42001	98443	43558	56442	01557	57999	45
16	42047	98440	43607	56393	01560	57953	44
17	42093	98436	43657	56343	01564	57907	43
18	42139	98433	43707	56293	01567	57860	42
19	42186	98429	43756	56244	01571	57814	41
20	9.42232	9.98426	9.43806	10.56194	10.01574	10.57768	40
21	42278	98422	43855	56145	01578	57722	39
22	42324	98419	43905	56095	01581	57676	38
23	42370	98415	43954	56046	01584	57630	37
24	42416	98412	44004	55996	01588	57584	36
25	42461	98409	44053	55947	01591	57538	35
26	42507	98405	44102	55898	01595	57493	34
27	42553	98402	44151	55848	01598	57447	33
28	42599	98398	44201	55799	01602	57401	32
29	42644	98395	44250	55750	01605	57356	31
30	9.42690	9.98391	9.44299	10.55701	10.01609	10.57310	30
31	42735	98388	44348	55652	01612	57265	29
32	42781	98384	44397	55603	01616	57219	28
33	42826	98381	44446	55554	01619	57174	27
34	42872	98377	44495	55505	01623	57128	26
35	42917	98373	44544	55456	01626	57083	25
36	42962	98370	44592	55408	01630	57038	24
37	43007	98366	44641	55359	01634	56993	23
38	43053	98363	44690	55310	01637	56947	22
39	43098	98359	44738	55262	01641	56902	21
40	9.43143	9.98356	9.44787	10.55213	10.01644	10.56857	20
41	43188	98352	44836	55164	01648	56812	19
42	43233	98349	44884	55116	01651	56767	18
43	43278	98345	44933	55067	01655	56722	17
44	43323	98342	44981	55019	01658	56677	16
45	43367	98338	45029	54971	01662	56632	15
46	43412	98334	45078	54922	01666	56588	14
47	43457	98331	45126	54874	01669	56543	13
48	43502	98327	45174	54826	01673	56498	12
49	43546	98324	45222	54778	01676	56454	11
50	9.43591	9.98320	9.45271	10.54729	10.01680	10.56409	10
51	43635	98317	45319	54681	01683	56365	9
52	43680	98313	45367	54633	01687	56320	8
53	43724	98309	45415	54585	01691	56276	7
54	43769	98306	45463	54537	01694	56231	6
55	43813	98302	45511	54489	01698	56187	5
56	43857	98299	45559	54441	01701	56143	4
57	43901	98295	45606	54394	01705	56099	3
58	43946	98291	45654	54346	01708	56054	2
59	43990	98288	45702	54298	01712	56010	1
60	44034	98284	45750	54250	01716	55966	0
	Co-sine.	Sine.	Co-tang.	Tang.	Co-secant.	Secant.	M.

74 Degrees.

A Table of Artificial Sines, Tang. and Sec. 16 Degrees.

M.	Sine.	Co fine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.44034	9.98284	9.45750	10.54250	10.01716	10.55966	60
1	44078	98281	45797	54203	01719	55922	59
2	44122	98277	45845	54155	01723	55878	58
3	44166	98273	45892	54108	01727	55834	57
4	44210	98270	45940	54060	01730	55790	56
5	44253	98266	45987	54013	01734	55746	55
6	44297	98262	46035	53965	01738	55703	54
7	44341	98259	46082	53918	01741	55659	53
8	44385	98255	46130	53870	01745	55615	52
9	44428	98251	46177	53823	01749	55572	51
10	9.44472	9.98248	9.46224	10.53776	10.01752	10.55528	50
11	44515	98244	46271	53728	01756	55484	49
12	44559	98240	46319	53681	01760	55441	48
13	44602	98237	46366	53634	01763	55397	47
14	44646	98233	46413	53587	01767	55354	46
15	44689	98229	46460	53540	01771	55311	45
16	44733	98226	46507	53493	01774	55267	44
17	44776	98222	46554	53446	01778	55224	43
18	44819	98218	46601	53399	01782	55181	42
19	44862	98215	46648	53352	01785	55138	41
20	9.44905	9.98211	9.46694	10.53306	10.01789	10.55095	40
21	44948	98207	46741	53259	01793	55051	39
22	44991	98203	46788	53212	01796	55008	38
23	45035	98200	46835	53165	01800	54965	37
24	45077	98196	46881	53119	01804	54923	36
25	45120	98192	46928	53072	01808	54880	35
26	45163	98189	46975	53025	01811	54837	34
27	45206	98185	47021	52979	01815	54794	33
28	45249	98181	47068	52932	01819	54751	32
29	45292	98177	47114	52886	01823	54708	31
30	9.45334	9.98174	9.47160	10.52840	10.01826	10.54666	30
31	45377	98170	47207	52793	01830	54624	29
32	45419	98166	47253	52747	01834	54581	28
33	45462	98162	47299	52701	01838	54538	27
34	45504	98159	47346	52654	01841	54496	26
35	45547	98155	47392	52608	01845	54453	25
36	45589	98151	47438	52562	01849	54411	24
37	45632	98147	47484	52516	01853	54368	23
38	45674	98144	47530	52470	01856	54326	22
39	45716	98140	47576	52424	01860	54284	21
40	9.45758	9.98136	9.47622	10.52378	10.01864	10.54242	20
41	45801	98132	47668	52332	01868	54199	19
42	45843	98128	47714	52286	01871	54157	18
43	45885	98125	47760	52240	01875	54115	17
44	45927	98121	47806	52194	01879	54073	16
45	45969	98117	47852	52148	01883	54031	15
46	46011	98113	47897	52102	01887	53989	14
47	46053	98109	47943	52057	01890	53947	13
48	46095	98106	47989	52011	01894	53905	12
49	46136	98102	48034	51965	01898	53864	11
50	9.46178	9.98098	9.48080	10.51920	10.01902	10.53822	10
51	46220	98094	48126	51874	01906	53780	9
52	46262	98090	48171	51829	01910	53738	8
53	46303	98087	48217	51783	01913	53697	7
54	46345	98083	48262	51738	01917	53655	6
55	46386	98079	48307	51692	01921	53614	5
56	46428	98075	48353	51647	01925	53572	4
57	46469	98071	48398	51602	01929	53531	3
58	46511	98067	48443	51557	01933	53489	2
59	46552	98063	48489	51511	01937	53448	1
60	46594	98060	48534	51466	01940	53406	0
	Co-fine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M

R r

73 Degrees.

A Table of Artificial Sines, Tang. and Sec. 17 Degrees.

M.	Sine.	Co-sine.	Tangent	Co-tang.	Secant.	Co-secant.	
0	9.46593	9.98060	9.48534	10.51466	10.01940	10.53406	60
1	46635	98056	48579	51421	01944	53365	59
2	46676	98052	48624	51376	01948	53324	58
3	46717	98048	48669	51331	01952	53283	57
4	46758	98044	48714	51286	01956	53241	56
5	46800	98040	48759	51241	01960	53200	55
6	46841	98036	48804	51196	01964	53159	54
7	46882	98032	48849	51151	01968	53118	53
8	46923	98029	48894	51106	01971	53077	52
9	46964	98025	48939	51061	01975	53036	51
10	47005	9.98021	9.48984	10.51016	10.01979	10.52995	50
11	47045	98017	49029	50971	01983	52954	49
12	47086	98013	49073	50927	01987	52914	48
13	47127	98009	49118	50882	01991	52873	47
14	47168	98005	49163	50837	01995	52832	46
15	47209	98001	49207	50793	01999	52791	45
16	47249	97997	49252	50748	02003	52751	44
17	47290	97993	49296	50703	02007	52710	43
18	47330	97989	49341	50659	02010	52670	42
19	47371	97986	49385	50614	02014	52629	41
20	9.47411	9.97982	9.49430	10.50570	10.02018	10.52588	40
21	47452	97978	49474	50526	02022	52548	39
22	47492	97974	49519	50481	02026	52508	38
23	47533	97970	49563	50437	02030	52467	37
24	47573	97966	49607	50393	02034	52427	36
25	47613	97962	49651	50348	02038	52387	35
26	47654	97958	49696	50304	02042	52346	34
27	47694	97954	49740	50260	02046	52306	33
28	47734	97950	49784	50216	02050	52266	32
29	47774	97946	49828	50172	02054	52226	31
30	9.47814	9.97942	9.49872	10.50128	10.02058	10.52186	30
31	47854	97938	49916	50084	02062	52146	29
32	47894	97934	49960	50040	02066	52106	28
33	47934	97930	50004	49996	02070	52066	27
34	47974	97926	50048	49952	02074	52026	26
35	48014	97922	50092	49908	02078	51986	25
36	48054	97918	50136	49864	02082	51946	24
37	48094	97914	50180	49820	02086	51906	23
38	48133	97910	50223	49776	02090	51867	22
39	48173	97906	50267	49733	02094	51827	21
40	9.48213	9.97902	9.50311	10.49689	10.02098	10.51787	20
41	48252	97898	50355	49645	02102	51747	19
42	48292	97894	50398	49602	02106	51708	18
43	48332	97890	50442	49558	02110	51668	17
44	48371	97886	50485	49515	02114	51629	16
45	48411	97882	50529	49471	02118	51589	15
46	48450	97878	50572	49428	02122	51550	14
47	48489	97874	50616	49384	02126	51510	13
48	48529	97870	50659	49341	02130	51471	12
49	48568	97866	50703	49297	02134	51432	11
50	9.48607	9.97861	9.50746	10.49254	10.02139	10.51392	10
51	48647	97857	50789	49211	02143	51353	9
52	48686	97853	50833	49167	02147	51314	8
53	48725	97849	50876	49124	02151	51275	7
54	48764	97845	50919	49081	02155	51236	6
55	48803	97841	50962	49038	02159	51197	5
56	48842	97837	51005	48995	02163	51158	4
57	48881	97833	51048	48951	02167	51119	3
58	48920	97829	51092	48908	02171	51080	2
59	48959	97825	51135	48865	02175	51041	1
60	48998	97821	51178	48822	02179	51002	0
	Co-sine.	Sine	Co-tang.	Tangent.	Co-secant.	Secant.	M:

A Table of Artificial Sines, Tang. and Sec. 18 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.48998	9.97821	9.51178	10.48822	10.02179	10.51002	60
1	49037	97817	51221	48779	02183	50963	59
2	49076	97812	51264	48736	02188	50924	58
3	49115	97808	51306	48694	02192	50885	57
4	49153	97804	51349	48651	02196	50847	56
5	49192	97800	51392	48608	02200	50808	55
6	49231	97796	51435	48565	02204	50769	54
7	49269	97792	51478	48522	02208	50731	53
8	49308	97788	51520	48480	02212	50692	52
9	49347	97784	51563	48437	02216	50653	51
10	9.49385	9.97779	9.51606	10.48394	10.02221	10.50615	50
11	49424	97775	51648	48352	02225	50576	49
12	49462	97771	51691	48309	02229	50538	48
13	49500	97767	51734	48266	02233	50500	47
14	49539	97763	51776	48224	02237	50461	46
15	49577	97759	51819	48181	02241	50423	45
16	49615	97754	51861	48139	02246	50385	44
17	49654	97750	51903	48097	02250	50340	43
18	49692	97746	51946	48054	02254	50308	42
19	49730	97742	51988	48012	02258	50270	41
20	9.49768	9.97738	9.52031	10.47969	10.02262	10.50232	40
21	49806	97733	52073	47927	02266	50194	39
22	49840	97729	52115	47885	02271	50156	38
23	49882	97725	52157	47843	02275	50118	37
24	49920	97721	52200	47800	02279	50080	36
25	49958	97717	52242	47758	02283	50042	35
26	49996	97713	52284	47716	02287	50004	34
27	50034	97708	52326	47674	02292	49966	33
28	50072	97704	52368	47632	02296	49928	32
29	50110	97700	52410	47590	02300	49890	31
30	9.50148	9.97696	9.52452	10.47548	10.02304	10.49852	30
31	50185	97691	52494	47506	02309	49815	29
32	50223	97687	52536	47464	02313	49777	28
33	50261	97683	52578	47422	02317	49739	27
34	50298	97679	52620	47380	02321	49702	26
35	50336	97674	52661	47339	02326	49664	25
36	50373	97670	52703	47297	02330	49626	24
37	50411	97666	52745	47255	02334	49589	23
38	50448	97662	52787	47213	02338	49551	22
39	50486	97657	52829	47171	02343	49514	21
40	9.50523	9.97653	9.52870	10.47130	10.02347	10.49477	20
41	50561	97649	52912	47088	02351	49439	19
42	50598	97645	52953	47047	02355	49402	18
43	50635	97640	52995	47005	02360	49365	17
44	50673	97636	53037	46963	02364	49327	16
45	50710	97632	53078	46922	02368	49290	15
46	50747	97627	53120	46880	02372	49253	14
47	50784	97623	53161	46839	02377	49216	13
48	50821	97619	53202	46797	02381	49179	12
49	50858	97615	53244	46756	02385	49142	11
50	9.50896	9.97610	9.53285	10.46715	10.02390	10.49104	10
51	50933	97606	53327	46673	02394	49067	9
52	50970	97602	53368	46632	02398	49030	8
53	51006	97597	53409	46591	02403	48993	7
54	51043	97593	53450	46550	02407	48957	6
55	51080	97589	53492	46508	02411	48920	5
56	51117	97584	53533	46467	02416	48883	4
57	51154	97580	53574	46426	02420	48846	3
58	51191	97576	53615	46385	02424	48809	2
59	51227	97571	53656	46344	02429	48773	1
60	51264	97567	53697	46303	02433	48736	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A-Table of Artificial Sines, Tang. and Sec. 19 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9. 51264	9. 97567	9. 53697	10. 46303	10. 02433	10. 48736	60
1	51301	97563	53738	46262	02437	48699	59
2	51337	97558	53779	46221	02442	48662	58
3	51374	97554	53820	46180	02446	48626	57
4	51411	97550	53861	46139	02450	48589	56
5	51447	97545	53902	46098	02455	48553	55
6	51484	97541	53943	46057	02459	48516	54
7	51520	97536	53984	46016	02464	48480	53
8	51557	97532	54025	45975	02468	48443	52
9	51593	97528	54065	45935	02472	48407	51
10	9. 51629	9. 97523	9. 54106	10. 45894	10. 02477	10. 48371	50
11	51666	97519	54147	45853	02481	48334	49
12	51702	97514	54187	45813	02485	48298	48
13	51738	97510	54228	45772	02490	48262	47
14	51774	97506	54269	45731	02494	48226	46
15	51811	97501	54309	45691	02499	48189	45
16	51847	97497	54350	45650	02503	48153	44
17	51883	97492	54390	45610	02508	48117	43
18	51919	97488	54431	45569	02512	48081	42
19	51955	97484	54471	45529	02516	48045	41
20	9. 51991	9. 97479	9. 54512	10. 45488	10. 02521	10. 48009	40
21	52027	97475	54552	45448	02525	47973	39
22	52063	97470	54593	45407	02530	47937	38
23	52099	97466	54633	45367	02534	47901	37
24	52135	97461	54673	45326	02539	47865	36
25	52171	97457	54714	45286	02543	47829	35
26	52207	97452	54754	45246	02547	47793	34
27	52242	97448	54794	45206	02552	47758	33
28	52278	97444	54835	45165	02556	47722	32
29	52314	97439	54875	45125	02561	47686	31
30	9. 52350	9. 97435	9. 54915	10. 45085	10. 02565	10. 47650	30
31	52385	97430	54955	45045	02570	47615	29
32	52421	97426	54995	45005	02574	47579	28
33	52456	97421	55035	44965	02579	47544	27
34	52492	97417	55075	44925	02583	47508	26
35	52527	97412	55115	44885	02588	47473	25
36	52563	97408	55155	44845	02592	47437	24
37	52598	97403	55195	44805	02597	47402	23
38	52634	97399	55235	44765	02601	47366	22
39	52669	97394	55275	44725	02606	47331	21
40	9. 52705	9. 97390	9. 55315	10. 44685	10. 02610	10. 47295	20
41	52740	97385	55355	44645	02615	47260	19
42	52775	97381	55395	44605	02619	47225	18
43	52810	97376	55434	44566	02624	47189	17
44	52846	97372	55474	44526	02628	47154	16
45	52881	97367	55514	44486	02633	47119	15
46	52916	97362	55554	44446	02637	47084	14
47	52951	97358	55593	44407	02642	47049	13
48	52986	97353	55633	44367	02647	47014	12
49	53021	97349	55673	44327	02651	46979	11
50	9. 53056	9. 97344	9. 55712	10. 44288	10. 02656	10. 46944	10
51	53091	97340	55752	44248	02660	46908	9
52	53126	97335	55791	44209	02665	46873	8
53	53161	97331	55831	44169	02669	46839	7
54	53196	97326	55870	44130	02674	46804	6
55	53231	97322	55910	44090	02678	46769	5
56	53266	97317	55949	44051	02683	46734	4
57	53301	97312	55989	44011	02688	46699	3
58	53336	97308	56028	43972	02692	46664	2
59	53370	97303	56067	43933	02697	46630	1
60	53405	97299	56107	43893	02701	46595	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

70 Degrees.

A Table of Artificial Sines, Tang. and Sec. 20 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9. 53405	9. 97299	9. 56107	10. 43893	10. 02701	10. 46595	60
1	53440	97294	56146	43854	02706	46560	59
2	53475	97289	56185	43815	02711	46525	58
3	53509	97285	56224	43776	02715	46491	57
4	53544	97280	56264	43736	02720	46456	56
5	53578	97275	56303	43697	02724	46422	55
6	53613	97271	56342	43658	02729	46387	54
7	53647	97266	56381	43619	02734	46353	53
8	53682	97262	56420	43580	02738	46318	52
9	53716	97257	56459	43541	02743	46284	51
10	9. 53751	9. 97252	9. 56498	10. 43502	10. 02745	10. 46249	50
11	53785	97248	56537	43463	02752	46215	49
12	53819	97243	56576	43424	02757	46181	48
13	53854	97238	56615	43385	02762	46146	47
14	53888	97234	56654	43346	02766	46112	46
15	53922	97229	56693	43307	02771	46078	45
16	53957	97224	56732	43268	02776	46043	44
17	53991	97220	56771	43229	02780	46009	43
18	54025	97215	56810	43190	02785	45975	42
19	54059	97210	56849	43151	02789	45941	41
20	9. 54093	9. 97206	9. 56887	10. 43113	10. 02794	10. 45909	40
21	54127	97201	56926	43074	02799	45873	39
22	54161	97196	56965	43035	02804	45839	38
23	54195	97192	57004	42996	02808	45805	37
24	54229	97187	57042	42958	02813	45771	36
25	54263	97182	57081	42919	02818	45737	35
26	54297	97178	57120	42880	02822	45703	34
27	54331	97173	57158	42842	02827	45669	33
28	54365	97168	57197	42803	02832	45635	32
29	54399	97163	57235	42765	02837	45601	31
30	9. 54432	9. 97159	9. 57274	10. 42726	10. 02841	10. 45567	30
31	54466	97154	57312	42688	02846	45534	29
32	54500	97149	57351	42649	02851	45500	28
33	54534	97145	57389	42611	02855	45466	27
34	54567	97140	57428	42572	02860	45433	26
35	54601	97135	57466	42534	02865	45399	25
36	54635	97130	57504	42496	02870	45365	24
37	54668	97126	57543	42457	02874	45332	23
38	54702	97121	57581	42419	02879	45298	22
39	54735	97116	57619	42381	02884	45265	21
40	9. 54769	9. 97111	9. 57658	10. 42342	10. 02889	10. 45231	20
41	54802	97106	57696	42304	02893	45198	19
42	54836	97102	57734	42266	02898	45164	18
43	54869	97097	57772	42228	02903	45131	17
44	54903	97092	57810	42190	02908	45097	16
45	54936	97087	57849	42151	02913	45064	15
46	54969	97083	57887	42113	02917	45031	14
47	55003	97078	57925	42075	02922	44997	13
48	55036	97073	57963	42037	02927	44964	12
49	55069	97068	58001	41999	02932	44931	11
50	9. 55102	9. 97063	9. 58039	10. 41961	10. 02937	10. 44898	10
51	55136	97059	58077	41923	02941	44864	9
52	55169	97054	58115	41885	02946	44831	8
53	55202	97049	58153	41847	02951	44798	7
54	55235	97044	58191	41809	02956	44765	6
55	55268	97039	58229	41771	02961	44732	5
56	55301	97034	58267	41733	02965	44699	4
57	55334	97030	58304	41696	02970	44666	3
58	55367	97025	58342	41658	02975	44633	2
59	55400	97020	58380	41620	02980	44600	1
60	55433	97015	58418	41582	02985	44567	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.	

A Table of Artificial Sines, Tang. and Sec. 21 Degrees.

M.	Sine.	Co-line.	Tang.	Co-Tang.	Secant.	Co-secant	
0	9. 55433	9. 97015	9. 58418	10. 41582	10. 02985	10. 44567	60
1	55460	97010	58455	41545	02990	44534	59
2	55499	97005	58493	41507	02995	44501	58
3	55531	97001	58531	41469	02999	44468	57
4	55564	96996	58569	41431	03004	44436	56
5	55597	96991	58606	41394	03009	44403	55
6	55630	96986	58644	41356	03014	44370	54
7	55663	96981	58681	41319	03019	44337	53
8	55695	96976	58719	41281	03024	44305	52
9	55728	96971	58757	41243	03029	44272	51
10	9. 55761	9. 96966	9. 58794	10. 41206	10. 03034	10. 44239	50
11	55793	96962	58832	41168	03038	44207	49
12	55826	96957	58869	41131	03043	44174	48
13	55858	96952	58907	41093	03048	44142	47
14	55891	96947	58944	41056	03053	44109	46
15	55923	96942	58981	41019	03058	44077	45
16	55956	96937	59019	40981	03063	44044	44
17	55988	96932	59056	40944	03068	44012	43
18	56021	96927	59094	40906	03073	43979	42
19	56053	96922	59131	40869	03078	43947	41
20	9. 56085	9. 96917	9. 59168	10. 40832	10. 03083	10. 43914	40
21	56118	96912	59205	40795	03088	43882	39
22	56150	96907	59243	40757	03093	43850	38
23	56182	96903	59280	40720	03097	43818	37
24	56215	96898	59317	40683	03102	43785	36
25	56247	96893	59354	40646	03107	43753	35
26	56279	96888	59391	40609	03112	43721	34
27	56311	96883	59429	40571	03117	43689	33
28	56343	96878	59466	40534	03122	43657	32
29	56375	96873	59503	40497	03127	43625	31
30	9. 56408	9. 96868	9. 59540	10. 40460	10. 03132	10. 43592	30
31	56440	96863	59577	40423	03137	43560	29
32	56472	96858	59614	40386	03142	43528	28
33	56504	96853	59651	40349	03147	43496	27
34	56536	96848	59688	40312	03152	43464	26
35	56568	96843	59725	40275	03157	43432	25
36	56599	96838	59762	40238	03162	43400	24
37	56631	96833	59799	40201	03167	43369	23
38	56663	96828	59835	40165	03172	43337	22
39	56695	96823	59872	40128	03177	43305	21
40	9. 56727	9. 96818	9. 59909	10. 40091	10. 03182	10. 43273	20
41	56759	96813	59946	40054	03187	43241	19
42	56790	96808	59983	40017	03192	43210	18
43	56822	96803	60019	39981	03197	43178	17
44	56854	96798	60056	39944	03202	43146	16
45	56886	96793	60093	39907	03207	43114	15
46	56917	96788	60130	39870	03202	43083	14
47	56949	96783	60166	39834	03217	43051	13
48	56980	96778	60203	39797	03222	43020	12
49	57012	96772	60239	39760	03228	42988	11
50	9. 57044	9. 96767	9. 60276	10. 39724	10. 03232	10. 42956	10
51	57075	96762	60313	39687	03238	42925	9
52	57107	96757	60349	39651	03243	42893	8
53	57138	96752	60386	39614	03248	42862	7
54	57169	96747	60422	39578	03253	42830	6
55	57201	96742	60459	39541	03258	42799	5
56	57232	96737	60495	39505	03263	42768	4
57	57264	96732	60532	39468	03268	42736	3
58	57295	96727	60568	39432	03273	42705	2
59	57326	96722	60605	39395	03278	42674	1
60	57357	96717	60641	39359	03283	42642	0
	Co-line.	Sine.	Co tang.	Tang.	Co-secant.	Secant.	

68 Degrees.

A Table of Artificial Sines, Tang. and Sec. 22 Degrees.

M.	Sine.	Co sine	Tang.	Co-tang.	Secant.	Co-secant	
0	9.57358	9.96717	9.60641	10.39359	10.03283	10.42642	60
1	57389	96711	60677	39323	03289	42611	59
2	57420	96706	60714	39186	03294	42580	58
3	57451	96701	60750	39150	03299	42549	57
4	57482	96696	60786	39114	03304	42518	56
5	57514	96691	60823	39177	03309	42486	55
6	57545	96686	60859	39141	03314	42455	54
7	57576	96681	60895	39105	03319	42424	53
8	57607	96676	60931	39069	03324	42393	52
9	57638	96670	60967	39033	03330	42362	51
10	9.57669	9.96665	9.61004	10.38996	10.03335	10.42331	50
11	57700	96660	61040	38960	03340	42300	49
12	57731	96655	61076	38924	03345	42269	48
13	57762	96650	61112	38888	03350	42238	47
14	57793	96645	61148	38852	03355	42207	46
15	57824	96640	61184	38816	03360	42176	45
16	57855	96634	61220	38780	03366	42145	44
17	57885	96629	61256	38744	03371	42115	43
18	57916	96624	61292	38708	03376	42084	42
19	57947	96619	61328	38672	03381	42053	41
20	9.57978	9.96614	9.61364	10.38636	10.03386	10.42022	40
21	58008	96608	61400	38600	03392	41992	39
22	58039	96603	61436	38564	03397	41961	38
23	58070	96598	61472	38528	03402	41930	37
24	58100	96593	61508	38492	03407	41899	36
25	58131	96588	61544	38456	03412	41869	35
26	58162	96582	61579	38421	03418	41838	34
27	58192	96577	61615	38385	03423	41808	33
28	58223	96572	61651	38349	03428	41777	32
29	58253	96567	61687	38313	03433	41747	31
30	9.58284	9.96562	9.61722	10.38278	10.03438	10.41716	30
31	58314	96556	61758	38242	03444	41686	29
32	58345	96551	61794	38206	03449	41655	28
33	58375	96546	61830	38170	03454	41625	27
34	58406	96541	61865	38135	03459	41594	26
35	58436	96535	61901	38099	03465	41564	25
36	58467	96530	61936	38063	03470	41533	24
37	58497	96525	61972	38028	03475	41503	23
38	58527	96520	62008	37992	03480	41473	22
39	58557	96514	62043	37957	03486	41443	21
40	9.58588	9.96509	9.62079	10.37921	10.03491	10.41412	20
41	58618	96504	62114	37886	03496	41382	19
42	58648	96498	62150	37850	03502	41352	18
43	58678	96493	62185	37815	03507	41322	17
44	58708	96488	62221	37779	03512	41291	16
45	58739	96483	62256	37744	03517	41261	15
46	58769	96477	62291	37708	03523	41231	14
47	58799	96472	62327	37673	03528	41201	13
48	58829	96467	62362	37638	03533	41171	12
49	58859	96461	62398	37602	03539	41141	11
50	9.58889	9.96456	9.62433	10.37567	10.03544	10.41111	10
51	58919	96451	62468	37532	03549	41081	9
52	58949	96445	62504	37496	03555	41051	8
53	58979	96440	62539	37461	03560	41021	7
54	59009	96435	62574	37426	03565	40991	6
55	59039	96429	62609	37391	03571	40961	5
56	59069	96424	62645	37355	03576	40931	4
57	59098	96419	62680	37320	03581	40902	3
58	59128	96413	62715	37285	03587	40872	2
59	59158	96408	62750	37250	03592	40842	1
60	59188	96403	62785	37215	03597	40812	0
	Co-sine.	Sine.	Co tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 23 Degrees.

M.	Sine.	Co Sine.	Tang.	Co. Tang.	Secant.	Co-secant.	
0	9. 59188	9. 96403	9. 62785	10. 37215	10. 3597	10. 40812	60
1	59217	96397	62820	37180	03603	40782	59
2	59247	96392	62855	37145	03608	40753	58
3	59277	96386	62890	37110	03613	40723	57
4	59307	96381	62926	37074	03619	40693	56
5	59336	96376	62961	37039	03624	40664	55
6	59366	96370	62996	37004	03630	40634	54
7	59396	96364	63031	36969	03631	40604	53
8	59425	96360	63066	36934	03640	40575	52
9	59455	96354	63101	36899	03646	40545	51
10	9. 59484	9. 96349	9. 63135	10. 36865	10. 03651	10. 40516	50
11	59514	96343	63170	36830	03657	40486	49
12	59543	96338	63205	36795	03662	40457	48
13	59573	96333	63240	36760	03667	40427	47
14	59602	96327	63275	36725	03673	40398	46
15	59632	96322	63310	36690	03678	40368	45
16	59661	96316	63345	36655	03684	40339	44
17	59690	96311	63379	36620	03689	40310	43
18	59720	96305	63414	36586	03695	40280	42
19	59749	96300	63449	36551	03700	40251	41
20	9. 59778	9. 96294	9. 63484	10. 36516	10. 03706	10. 40222	40
21	59808	96289	63519	36481	03711	40192	39
22	59837	96284	63553	36447	03716	40163	38
23	59866	96278	63588	36412	03722	40134	37
24	59895	96273	63623	36377	03727	40105	36
25	59924	96267	63657	36343	03733	40076	35
26	59954	96262	63692	36308	03738	40046	34
27	59983	96256	63726	36274	03744	40017	33
28	60012	96251	63761	36239	03749	39988	32
29	60041	96245	63796	36204	03755	39959	31
30	9. 60070	9. 96240	9. 63830	10. 36170	10. 03760	10. 39930	30
31	60099	96234	63865	36135	03766	39901	29
32	60128	96229	63899	36101	03771	39872	28
33	60157	96223	63934	36066	03777	39843	27
34	60186	96218	63968	36032	03782	39814	26
35	60215	96212	64003	35997	03788	39785	25
36	60244	96207	64037	35963	03793	39756	24
37	60273	96201	64072	35928	03798	39727	23
38	60302	96196	64106	35894	03804	39698	22
39	60331	96190	64140	35860	03810	39669	21
40	9. 60359	9. 96185	9. 64175	10. 35825	10. 03815	10. 39641	20
41	60388	96179	64209	35791	03821	39612	19
42	60417	96174	64243	35757	03826	39583	18
43	60446	96168	64278	35722	03832	39554	17
44	60474	96162	64312	35688	03838	39525	16
45	60503	96157	64346	35654	03843	39497	15
46	60532	96151	64381	35619	03849	39468	14
47	60561	96146	64415	35585	03855	39439	13
48	60589	96140	64449	35551	03860	39411	12
49	60618	96135	64483	35517	03866	39382	11
50	9. 60646	9. 96129	9. 64517	10. 35483	10. 03871	10. 39353	10
51	60675	96123	64552	35448	03877	39325	9
52	60704	96118	64586	35414	03882	39296	8
53	60732	96112	64620	35380	03888	39268	7
54	60761	96107	64654	35346	03893	39239	6
55	60789	96101	64688	35312	03900	39211	5
56	60818	96095	64722	35278	03905	39182	4
57	60846	96090	64756	35244	03910	39154	3
58	60874	96084	64790	35210	03916	39125	2
59	60903	96079	64824	35176	03921	39097	1
60	60931	96073	64858	35142	03927	39069	0
	Co-sine.	Sine.	Co-Tan.	Tangent.	Co-secan.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 24 Degrees.

M.	Sine.	Co-fine.	Tang.	Co-Tang.	Secant.	Co-secant	
0	9.60931	9.96073	9.64858	10.35142	10.03927	10.39069	60
1	60960	96067	64892	35108	03933	39040	59
2	60988	96062	64926	35074	03938	39012	58
3	61016	96056	64960	35040	03944	38984	57
4	61045	96050	64994	35006	03950	38955	56
5	61073	96045	65028	34972	03955	38927	55
6	61101	96039	65062	34938	03961	38899	54
7	61129	96034	65096	34904	03966	38871	53
8	61158	96028	65130	34870	03972	38842	52
9	61186	96022	65164	34836	03978	38814	51
10	9.61214	9.96017	9.65197	10.34803	10.03983	10.38786	50
11	61242	96011	65231	34769	03989	38758	49
12	61270	96005	65265	34735	03995	38730	48
13	61298	95999	65299	34701	04000	38702	47
14	61326	95994	65333	34667	04006	38674	46
15	61354	95988	65366	34634	04012	38646	45
16	61382	95982	65400	34600	04018	38617	44
17	61411	95977	65434	34566	04023	38589	43
18	61438	95971	65467	34533	04029	38561	42
19	61466	95965	65501	34499	04035	38534	41
20	9.61494	9.95960	9.65535	10.34405	10.04040	10.38506	40
21	61522	95954	65568	34432	04046	38478	39
22	61550	95948	65602	34398	04052	38450	38
23	61578	95942	65636	34364	04058	38422	37
24	61606	95937	65669	34331	04063	38394	36
25	61634	95931	65703	34297	04069	38366	35
26	61662	95925	65736	34264	04075	38338	34
27	61689	95920	65770	34230	04080	38311	33
28	61717	95914	65803	34197	04086	38283	32
29	61745	95908	65837	34163	04092	38255	31
30	9.61773	9.95902	9.65870	10.34130	10.04098	10.38227	30
31	61800	95897	65904	34096	04103	38200	29
32	61828	95891	65937	34063	04109	38172	28
33	61856	95885	65971	34029	04115	38144	27
34	61883	95879	66004	33996	04121	38117	26
35	61911	95873	66038	33962	04127	38089	25
36	61939	95868	66071	33929	04132	38061	24
37	61966	95862	66104	33896	04138	38034	23
38	61994	95856	66138	33862	04144	38006	22
39	62021	95850	66171	33829	04150	37979	21
40	9.62049	9.95844	9.66204	10.33796	10.04156	10.37951	20
41	62076	95839	66238	33762	04161	37924	19
42	62104	95833	66271	33729	04167	37896	18
43	62131	95827	66304	33696	04173	37869	17
44	62159	95821	66337	33663	04179	37841	16
45	62186	95815	66371	33629	04185	37814	15
46	62214	95810	66404	33596	04190	37786	14
47	62241	95804	66437	33563	04196	37759	13
48	62268	95798	66470	33530	04202	37732	12
49	62296	95792	66503	33497	04208	37704	11
50	9.62323	9.95786	9.66537	10.33463	10.04214	10.37677	10
51	62350	95780	66570	33430	04220	37650	9
52	62377	95775	66603	33397	04225	37623	8
53	62405	95769	66636	33364	04231	37595	7
54	62432	95763	66669	33331	04237	37568	6
55	62459	95757	66702	33298	04243	37541	5
56	62486	95751	66735	33265	04249	37514	4
57	62513	95745	66768	33232	04255	37487	3
58	62541	95739	66801	33199	04261	37459	2
59	62568	95733	66834	33166	04267	37432	1
60	62595	95728	66867	33133	04272	37405	0
	Co-fine.	Sine.	Co tang.	Tang.	Co-secant.	Secant.	

65 Degrees.

A Table of Artificial Sines, Tang. and Sec. 25 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	9. 62595	9. 95728	9. 66867	10. 33133	10. 04272	10. 37405	60
1	62622	95722	66900	33100	04278	37378	59
2	62649	95716	66933	33067	04284	37351	58
3	62676	95710	66966	33034	04290	37324	57
4	62703	95704	66999	33001	04296	37297	56
5	62730	95698	67032	32968	04302	37270	55
6	62757	95692	67065	32935	04308	37243	54
7	62784	95686	67098	32902	04314	37216	53
8	62811	95680	67131	32869	04320	37189	52
9	62838	95674	67163	32837	04326	37162	51
10	9. 62865	9. 95668	9. 67196	10. 32804	10. 04332	10. 37135	50
11	62892	95662	67229	32771	04337	37108	49
12	62918	95657	67262	32738	04343	37082	48
13	62945	95651	67295	32705	04349	37055	47
14	62972	95645	67327	32673	04355	37028	46
15	62999	95639	67360	32640	04361	37001	45
16	63026	95633	67393	32607	04367	36974	44
17	63052	95627	67426	32574	04373	36948	43
18	63079	95621	67458	32542	04379	36921	42
19	63106	95615	67491	32509	04385	36894	41
20	9. 63133	9. 95609	9. 67524	10. 32476	10. 04391	10. 36867	40
21	63159	95603	67556	32444	04397	36841	39
22	63186	95597	67589	32411	04403	36814	38
23	63212	95591	67622	32378	04409	36787	37
24	63239	95585	67654	32346	04415	36761	36
25	63266	95579	67687	32313	04421	36734	35
26	63292	95573	67719	32281	04427	36708	34
27	63319	95567	67752	32248	04433	36681	33
28	63345	95561	67785	32215	04439	36655	32
29	63372	95555	67817	32183	04445	36628	31
30	9. 63398	9. 95549	9. 67850	10. 32150	10. 04451	10. 36602	30
31	63425	95543	67882	32118	04457	36575	29
32	63451	95537	67915	32085	04463	36549	28
33	63478	95531	67947	32053	04469	36522	27
34	63504	95525	67980	32020	04475	36496	26
35	63531	95519	68012	31988	04481	36469	25
36	63557	95513	68044	31956	04487	36443	24
37	63583	95507	68077	31923	04493	36417	23
38	63610	95500	68109	31891	04500	36390	22
39	63636	95494	68142	31858	04506	36364	21
40	9. 63662	9. 95488	9. 68174	10. 31826	10. 04512	10. 36338	20
41	63689	95482	68206	31794	04518	36311	19
42	63715	95476	68239	31761	04524	36285	18
43	63741	95470	68271	31729	04530	36259	17
44	63767	95464	68303	31697	04536	36233	16
45	63793	95458	68336	31664	04542	36206	15
46	63820	95452	68368	31632	04548	36180	14
47	63846	95446	68400	31600	04554	36154	13
48	63872	95440	68432	31568	04560	36128	12
49	63898	95434	68465	31535	04566	36102	11
50	9. 63924	9. 95427	9. 68497	10. 31503	10. 04573	10. 36076	10
51	63950	95421	68529	31471	04579	36050	9
52	63976	95415	68561	31439	04585	36024	8
53	64002	95409	68593	31407	04591	35998	7
54	64028	95403	68626	31374	04597	35972	6
55	64054	95397	68658	31342	04603	35946	5
56	64080	95391	68690	31310	04609	35920	4
57	64106	95384	68722	31278	04616	35894	3
58	64132	95378	68754	31246	04622	35868	2
59	64158	95372	68786	31214	04628	35842	1
60	64184	95366	68818	31182	04634	35816	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.	

64 Degrees.

A Table of Artificial Sines, Tang. and Sec. 26 Degrees.

M.	Sine.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.64184	9.95366	9.68818	10.31182	10.04634	10.35816	60
1	64210	95360	68850	31149	04640	35790	59
2	64236	95354	68882	31118	04646	35764	58
3	64262	95348	68914	31086	04652	35738	57
4	64288	95341	68946	31054	04659	35712	56
5	64313	95335	68978	31022	04665	35687	55
6	64339	95329	69010	30990	04671	35661	54
7	64365	95323	69042	30958	04677	35635	53
8	64391	95317	69074	30926	04683	35609	52
9	64417	95310	69106	30894	04690	35583	51
10	9.64442	9.95304	9.69138	10.30862	10.04696	10.35558	50
11	64468	95298	69170	30830	04702	35532	49
12	64494	95292	69202	30798	04708	35506	48
13	64519	95286	69234	30766	04714	35481	47
14	64545	95279	69266	30734	04721	35455	46
15	64571	95273	69297	30703	04727	35429	45
16	64596	95267	69329	30671	04733	35404	44
17	64622	95261	69361	30639	04739	35378	43
18	64647	95254	69393	30607	04746	35353	42
19	64673	95248	69425	30575	04752	35327	41
20	9.64698	9.95242	9.69457	10.30543	10.04758	10.35302	40
21	64724	95236	69488	30512	04764	35276	39
22	64749	95229	69520	30480	04771	35251	38
23	64775	95223	69552	30448	04777	35225	37
24	64800	95217	69584	30416	04783	35200	36
25	64826	95211	69615	30385	04789	35174	35
26	64851	95204	69647	30353	04796	35149	34
27	64877	95198	69679	30321	04802	35123	33
28	64902	95192	69710	30290	04808	35098	32
29	64927	95185	69742	30258	04815	35072	31
30	9.64953	9.95179	9.69774	10.30226	10.04821	10.35047	30
31	64978	95173	69805	30195	04827	35022	29
32	65003	95167	69837	30163	04833	34997	28
33	65029	95160	69868	30132	04840	34971	27
34	65054	95154	69900	30100	04846	34946	26
35	65079	95148	69932	30068	04852	34921	25
36	65104	95141	69963	30037	04859	34896	24
37	65130	95135	69995	30005	04865	34870	23
38	65155	95129	70026	29974	04871	34845	22
39	65180	95122	70058	29942	04878	34820	21
40	9.65205	9.95116	9.70089	10.29911	10.04884	10.34795	20
41	65230	95110	70121	29879	04890	34770	19
42	65255	95103	70152	29848	04897	34745	18
43	65281	95097	70184	29816	04903	34719	17
44	65306	95090	70215	29785	04910	34694	16
45	65331	95084	70247	29753	04916	34669	15
46	65356	95078	70278	29722	04922	34644	14
47	65381	95071	70309	29691	04929	34619	13
48	65406	95065	70341	29659	04935	34594	12
49	65431	95059	70372	29628	04941	34569	11
50	9.65456	9.95052	9.70404	10.29596	10.04948	10.34544	10
51	65481	95046	70435	29565	04954	34519	9
52	65506	95039	70466	29534	04961	34494	8
53	65531	95033	70498	29502	04967	34469	7
54	65556	95027	70529	29471	04973	34444	6
55	65580	95020	70560	29440	04980	34420	5
56	65605	95014	70592	29408	04986	34395	4
57	65630	95007	70623	29377	04993	34370	3
58	65655	95001	70654	29346	04999	34345	2
59	65680	94994	70685	29315	05005	34320	1
60	65705	94988	70717	29283	05012	34295	0
	Co line.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 27 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.65705	9.94988	9.70717	10.29283	10.05012	10.34295	60
1	65729	94982	70748	29252	05018	34270	59
2	65754	94975	70779	29221	05025	34246	58
3	65779	94969	70810	29190	05031	34221	57
4	65804	94962	70841	29159	05038	34196	56
5	65828	94956	70873	29127	05044	34172	55
6	65853	94949	70904	29096	05051	34147	54
7	65878	94943	70935	29065	05057	34122	53
8	65902	94936	70966	29034	05064	34097	52
9	65927	94930	70997	29003	05070	34073	51
10	9.65952	9.94923	9.71028	10.28972	10.05077	10.34048	50
11	65976	94917	71059	28941	05083	34024	49
12	66001	94910	71090	28910	05089	33999	48
13	66025	94904	71121	28879	05096	33974	47
14	66050	94898	71153	28847	05102	33950	46
15	66075	94891	71184	28816	05109	33925	45
16	66099	94884	71215	28785	05115	33901	44
17	66124	94878	71246	28754	05122	33876	43
18	66148	94871	71277	28723	05129	33852	42
19	66173	94865	71308	28692	05135	33827	41
20	9.66197	9.94858	9.71339	10.28661	10.05142	10.33803	40
21	66221	94852	71370	28630	05148	33779	39
22	66246	94845	71401	28599	05155	33754	38
23	66270	94839	71431	28568	05161	33730	37
24	66295	94832	71462	28538	05168	33705	36
25	66319	94826	71493	28507	05174	33681	35
26	66343	94819	71524	28476	05181	33657	34
27	66368	94813	71555	28445	05187	33632	33
28	66392	94806	71586	28414	05194	33608	32
29	66416	94799	71617	28383	05201	33584	31
30	9.66441	9.94793	9.71648	10.28352	10.05207	10.33559	30
31	66465	94786	71679	28321	05214	33535	29
32	66489	94780	71709	28291	05220	33511	28
33	66513	94773	71740	28260	05227	33487	27
34	66537	94767	71771	28229	05233	33463	26
35	66562	94760	71802	28198	05240	33438	25
36	66586	94753	71833	28167	05247	33414	24
37	66610	94747	71863	28137	05253	33390	23
38	66634	94740	71894	28106	05260	33366	22
39	66658	94734	71925	28075	05266	33342	21
40	9.66682	9.94727	9.71955	10.28045	10.05273	10.33318	20
41	66706	94720	71986	28014	05280	33293	19
42	66731	94714	72017	27983	05286	33269	18
43	66755	94707	72048	27952	05293	33245	17
44	66779	94700	72078	27922	05300	33221	16
45	66803	94694	72109	27891	05306	33197	15
46	66827	94687	72140	27860	05313	33173	14
47	66851	94680	72170	27830	05320	33149	13
48	66875	94674	72201	27799	05326	33125	12
49	66899	94667	72231	27769	05333	33101	11
50	9.66922	9.94660	9.72262	10.27738	10.05340	10.33078	10
51	66946	94654	72293	27707	05346	33054	9
52	66970	94647	72323	27678	05353	33030	8
53	66994	94640	72354	27646	05360	33006	7
54	67018	94634	72384	27616	05366	32982	6
55	67042	94627	72415	27585	05373	32958	5
56	67066	94620	72445	27555	05380	32934	4
57	67090	94614	72476	27524	05386	32910	3
58	67113	94607	72506	27493	05393	32887	2
59	67137	94600	72537	27463	05400	32863	1
60	67161	94593	72567	27433	05407	32839	0
Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.	

62 Degrees.

A Table of Artificial Sines, Tang. and Sec. 28 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.67161	9.94593	9.72567	10.27433	10.05407	10.32839	60
1	67185	94587	72598	27402	05413	32815	59
2	67208	94580	72628	27372	05420	32792	58
3	67232	94573	72659	27341	05427	32768	57
4	67256	94567	72689	27311	05433	32744	56
5	67280	94560	72720	27280	05440	32720	55
6	67303	94553	72750	27250	03447	32697	54
7	67327	94546	72780	27220	05454	32673	53
8	67350	94540	72811	27189	05460	32650	52
9	67374	94533	72841	27159	05467	32625	51
10	9.67398	9.94526	9.72872	10.27128	10.05474	10.32602	50
11	67421	94519	72902	27098	05481	32579	49
12	67445	94513	72932	27068	05487	32555	48
13	67468	94506	72963	27037	05494	32532	47
14	67492	94499	72993	27007	05501	32508	46
15	67515	94492	73023	26977	05508	32485	45
16	67539	94485	73054	26946	05515	32461	44
17	67562	94479	73084	26916	05521	32438	43
18	67586	94472	73114	26886	05528	32414	42
19	67609	94465	73144	26856	05535	32391	41
20	9.67633	9.94458	9.73175	10.26825	10.05542	10.32367	40
21	67656	94451	73205	26795	05549	32344	39
22	67680	94445	73235	26765	05555	32320	38
23	67703	94438	73265	26735	05562	32297	37
24	67726	94431	73295	26705	05569	32274	36
25	67750	94424	73326	26674	05576	32250	35
26	67773	94417	73356	26644	05583	32227	34
27	67796	94410	73386	26614	05590	32204	33
28	67820	94404	73416	26584	05596	32180	32
29	67843	94397	73446	26554	05603	32157	31
30	9.67866	9.94390	9.73476	10.26524	10.05610	10.32134	30
31	67890	94383	73507	26493	05617	32110	29
32	67913	94376	73537	26463	05624	32087	28
33	67936	94369	73567	26433	05631	32064	27
34	67959	94362	73597	26403	05638	32041	26
35	67982	94355	73627	26373	05645	32018	25
36	68006	94349	73657	26343	05651	31994	24
37	68029	94342	73687	26313	05658	31971	23
38	68052	94335	73717	26283	05665	31948	22
39	68075	94328	73747	26253	05672	31925	21
40	9.68098	9.94321	9.73777	10.26223	10.05679	10.31902	20
41	68121	94314	73807	26193	05686	31879	19
42	68144	94307	73837	26163	05693	31856	18
43	68167	94300	73867	26133	05700	31833	17
44	68190	94293	73897	26103	05707	31810	16
45	68213	94286	73927	26073	05714	31787	15
46	68237	94279	73957	26043	05721	31763	14
47	68260	94273	73987	26013	05727	31740	13
48	68282	94266	74017	25983	05734	31718	12
49	68305	94259	74047	25953	05741	31695	11
50	9.68328	9.94252	9.74077	10.25923	10.05748	10.31672	10
51	68351	94245	74107	25893	05755	31649	9
52	68374	94238	74137	25863	05762	31626	8
53	68397	94231	74166	25833	05769	31603	7
54	68420	94224	74196	25803	05776	31580	6
55	68443	94217	74226	25774	05783	31557	5
56	68466	94210	74256	25744	05790	31534	4
57	68489	94203	74286	25714	05797	31511	3
58	68511	94196	74316	25684	05804	31488	2
59	68534	94189	74345	25655	05811	31466	1
60	68557	94182	74375	25625	05818	31443	0
	Co-sine.	Sine	Co tang.	Tangent.	Co-secant	Secant.	M.

61 Degrees

A Table of Artificial Sines, Tang. and Sec. 29 Degrees

M.	Sine.	Co-sine.	Tangent	Co-tang.	Secant.	Co-secant.	
0	9.68557	9.94182	9.74375	10.25625	05818	10.31443	60
1	68580	94175	74405	25595	05825	31420	59
2	68603	94168	74435	25565	05832	31397	58
3	68625	94161	74465	25535	05839	31375	57
4	68648	94154	74495	25506	05846	31352	56
5	68671	94147	74524	25476	05853	31329	55
6	68694	94140	74554	25446	05860	31306	54
7	68716	94133	74583	25417	05867	31284	53
8	68739	94126	74613	25387	05874	31261	52
9	68762	94119	74643	25357	05881	31238	51
10	9.68784	9.94112	9.74673	10.25327	10.05888	10.31216	50
11	68807	94105	74702	25298	05895	31193	49
12	68829	94098	74732	25268	05902	31170	48
13	68852	94090	74762	25238	05910	31148	47
14	68875	94083	74791	25209	05917	31125	46
15	68897	94076	74821	25179	05924	31103	45
16	68920	94069	74851	25149	05931	31080	44
17	68942	94062	74880	25120	05938	31058	43
18	68965	94055	74910	25090	05945	31035	42
19	68987	94048	74939	25061	05952	31013	41
20	9.69010	9.94041	9.74969	10.25031	10.05959	10.30990	40
21	69032	94034	74998	25002	05966	30968	39
22	69055	94027	75028	24972	05973	30945	38
23	69077	94020	75058	24942	05980	30923	37
24	69100	94012	75087	24913	05988	30900	36
25	69122	94005	75117	24883	05995	30878	35
26	69144	93998	75146	24854	06002	30856	34
27	69167	93991	75176	24824	06009	30833	33
28	69189	93984	75205	24795	06016	30811	32
29	69212	93977	75235	24765	06023	30788	31
30	9.69234	9.93970	9.75264	10.24736	10.06030	10.30766	30
31	69256	93963	75294	24706	06037	30744	29
32	69279	93955	75323	24677	06045	30721	28
33	69301	93948	75353	24647	06052	30699	27
34	69323	93941	75382	24618	06059	30677	26
35	69345	93934	75411	24588	06066	30655	25
36	69368	93927	75441	24559	06073	30632	24
37	69390	93919	75470	24530	06080	30610	23
38	69412	93912	75500	24500	06088	30588	22
39	69434	93905	75529	24471	06095	30566	21
40	9.69456	9.93898	9.75558	10.24441	10.06102	10.30544	20
41	69479	93891	75588	24412	06109	30521	19
42	69501	93884	75617	24383	06116	30499	18
43	69523	93876	75647	24353	06124	30477	17
44	69545	93869	75676	24324	06131	30455	16
45	69567	93862	75705	24295	06138	30433	15
46	69589	93855	75735	24265	06145	30411	14
47	69611	93847	75764	24236	06153	30389	13
48	69633	93840	75793	24207	06160	30367	12
49	69655	93833	75822	24178	06167	30345	11
50	9.69677	9.93826	9.75852	10.24148	10.06174	10.30323	10
51	69699	93819	75881	24119	06181	30301	9
52	69721	93811	75910	24090	06189	30279	8
53	69743	93804	75939	24060	06196	30256	7
54	69765	93797	75969	24031	06203	30235	6
55	69787	93789	75998	24002	06210	30213	5
56	69809	93782	76027	23973	06218	30191	4
57	69831	93775	76056	23944	06225	30169	3
58	69853	93768	76086	23914	06232	30147	2
59	69875	93760	76115	23885	06240	30125	1
60	69897	93753	76144	23856	06247	30103	0
	Co-sine.	Sine	Co-tang.	Tangent.	Co-secant.	Secant.	M.

60 Degrees.

A Table of Artificial Sines, Tang. and Sec. 30 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-Tan.	Secant.	Co-secant.	
0	9.69897	9.93753	9.76144	10.23856	10.06247	10.30103	60
1	69919	93746	76173	23827	06254	30081	59
2	69941	93738	76202	23798	06261	30059	58
3	69963	93731	76231	23769	06269	30037	57
4	69984	93724	76261	23739	06276	30016	56
5	70006	93717	76290	23710	06283	29994	55
6	70028	93709	76319	23681	06291	29972	54
7	70050	93702	76348	23652	06298	29950	53
8	70072	93695	76377	23623	06305	29928	52
9	70093	93687	76406	23594	06313	29907	51
10	9.70115	9.93680	9.76435	10.23565	10.06320	10.29885	50
11	70137	93673	76464	23536	06327	29864	49
12	70159	93665	76493	23507	06335	29841	48
13	70180	93658	76522	23478	06342	29820	47
14	70202	93650	76551	23449	06350	29798	46
15	70224	93643	76580	23420	06357	29776	45
16	70245	93636	76609	23391	06364	29755	44
17	70267	93628	76639	23361	06372	29733	43
18	70288	93621	76668	23332	06379	29712	42
19	70310	93614	76697	23303	06386	29690	41
20	9.70332	9.93606	9.76725	10.23274	10.06394	10.29668	40
21	70353	93599	76754	23246	06401	29647	39
22	70375	93591	76783	23217	06409	29625	38
23	70396	93584	76812	23188	06416	29604	37
24	70418	93577	76841	23159	06423	29582	36
25	70439	93569	76870	23130	06431	29561	35
26	70461	93562	76899	23101	06438	29539	34
27	70482	93554	76928	23072	06446	29518	33
28	70504	93547	76957	23043	06453	29496	32
29	70525	93539	76986	23014	06461	29475	31
30	9.70547	9.93532	9.77015	10.22985	10.06465	10.29453	30
31	70568	93525	77044	22956	06475	29432	29
32	70590	93517	77073	22927	06483	29410	28
33	70611	93510	77101	22899	06490	29389	27
34	70633	93502	77130	22870	06498	29367	26
35	70654	93495	77159	22841	06505	29346	25
36	70675	93487	77188	22812	06513	29325	24
37	70697	93480	77217	22783	06520	29303	23
38	70718	93472	77246	22754	06528	29282	22
39	70739	93465	77274	22726	06535	29261	21
40	9.70761	9.93457	9.77303	10.22697	10.06543	10.29239	20
41	70782	93450	77332	22668	06550	29218	19
42	70803	93442	77361	22639	06558	29197	18
43	70824	93435	77390	22610	06565	29175	17
44	70846	93427	77418	22582	06573	29154	16
45	70867	93420	77447	22553	06580	29133	15
46	70888	93412	77476	22524	06588	29112	14
47	70909	93405	77505	22495	06595	29091	13
48	70931	93397	77533	22467	06603	29069	12
49	70952	93390	77562	22438	06610	29048	11
50	9.70973	9.93382	9.77591	10.22409	10.06618	10.29027	10
51	70994	93375	77619	22381	06625	29006	9
52	71015	93367	77648	22352	06633	28985	8
53	71036	93360	77677	22323	06640	28964	7
54	71058	93352	77705	22294	06648	28942	6
55	71079	93344	77734	22266	06656	28921	5
56	71100	93337	77763	22237	06663	28900	4
57	71121	93329	77791	22208	06671	28879	3
58	71142	93322	77820	22180	06678	28858	2
59	71163	93314	77849	22151	06686	28837	1
60	71184	93307	77877	22123	06693	28816	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M

59 Degrees.

A Table of Artificial Sines, Tang. and Sec. 31 Degrees.

M.	Sine.	Co Sine.	Tang.	Co. Tang.	Secant.	Co-secant.	
0	9.71184	9.93307	9.77877	10.22123	10.06693	10.28816	60
1	71205	93299	77906	22034	06701	28795	59
2	71226	93291	77935	22065	06709	28774	58
3	71247	93284	77963	22037	06716	28753	57
4	71268	93276	77992	22038	06724	28732	56
5	71289	93269	78021	21980	06731	28711	55
6	71310	93261	78049	21951	06739	28690	54
7	71331	93253	78077	21923	06747	28669	53
8	71352	93246	78106	21894	06754	28648	52
9	71373	93238	78135	21865	06762	28627	51
10	9.71393	9.93230	9.78163	10.21837	10.06770	10.28607	50
11	71414	93223	78192	21808	06777	28586	49
12	71435	93215	78220	21780	06785	28565	48
13	71456	93207	78249	21751	06792	28544	47
14	71477	93200	78277	21723	06800	28523	46
15	71498	93192	78306	21694	06808	28502	45
16	71519	93184	78334	21666	06816	28481	44
17	71539	93177	78363	21637	06823	28461	43
18	71560	93169	78391	21609	06831	28440	42
19	71581	93161	78419	21580	06839	28419	41
20	9.71602	9.93154	9.78448	10.21552	10.06846	10.28398	40
21	71622	93146	78476	21524	06854	28378	39
22	71643	93138	78505	21495	06862	28357	38
23	71664	93131	78533	21467	06869	28336	37
24	71685	93123	78562	21438	06877	28315	36
25	71705	93115	78590	21410	06885	28295	35
26	71726	93107	78618	21382	06893	28274	34
27	71747	93100	78647	21353	06900	28253	33
28	71767	93092	78675	21325	06908	28233	32
29	71788	93084	78704	21290	06916	28212	31
30	9.71809	9.93077	9.78732	10.21268	10.06923	9.28191	30
31	71829	93069	78760	21240	06931	28171	29
32	71850	93061	78789	21211	06939	28150	28
33	71870	93053	78817	21183	06947	28130	27
34	71891	93046	78845	21155	06954	28119	26
35	71911	93038	78874	21126	06962	28089	25
36	71932	93030	78902	21098	06970	28068	24
37	71952	93022	78930	21070	06978	28048	23
38	71973	93014	78959	21041	06985	28027	22
39	71993	93007	78987	21013	06993	28007	21
40	9.72014	9.92999	9.79015	10.20985	10.07001	10.27986	20
41	72034	92991	79043	20957	07009	27965	19
42	72055	92983	79072	20928	07017	27945	18
43	72075	92975	79100	20900	07024	27925	17
44	72096	92968	79128	20872	07032	27904	16
45	72116	92960	79156	20844	07040	27884	15
46	72137	92952	79185	20815	07048	27863	14
47	72157	92944	79213	20787	07056	27843	13
48	72177	92936	79241	20759	07064	27823	12
49	72198	92929	79269	20731	07071	27802	11
50	9.72218	9.92921	9.79297	10.20703	10.07079	10.27782	10
51	72238	92913	79326	20674	07087	27761	9
52	72259	92905	79354	20646	07095	27741	8
53	72279	92897	79382	20618	07103	27721	7
54	72299	92889	79410	20590	07111	27701	6
55	72320	92881	79438	20562	07119	27680	5
56	72340	92874	79466	20534	07126	27660	4
57	72360	92866	79495	20505	07134	27640	3
58	72381	92858	79523	20477	07142	27619	2
59	72401	92850	79551	20449	07150	27599	1
60	72421	92842	79579	20421	07158	27579	0
	Co-line.	Sine.	Co.tang.	Tangent.	Co-secant	Secant.	M.

58 Degrees.

A Table of Artificial Sines, Tang. and Sec. 32 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-Tan.	Secant.	Co-secant.	
0	9.72421	9.92842	9.79579	10.20421	10.07158	10.27579	60
1	72441	9.834	79607	20393	07166	27559	59
2	72461	92826	79635	20365	07174	27539	58
3	72482	92818	79663	20337	07182	27518	57
4	72502	92810	79691	20309	07190	27498	56
5	72522	92803	79719	20281	07197	27478	55
6	72542	92795	79747	20253	07205	27458	54
7	72562	92787	79776	20224	07213	27438	53
8	72582	92779	79804	20196	07221	27418	52
9	72602	92771	79832	20168	07229	27398	51
10	9.72622	9.92763	9.79860	10.20140	10.07237	10.27378	50
11	72643	92755	79888	20112	07245	27357	49
12	72663	92747	79916	20084	07253	27337	48
13	72683	92739	79944	20056	07261	27317	47
14	72703	92731	79972	20028	07269	27297	46
15	72723	92723	80000	20000	07277	27277	45
16	72743	92715	80028	19972	07285	27257	44
17	72763	92707	80056	19944	07293	27237	43
18	72783	92699	80084	19916	07301	27217	42
19	72803	92691	80112	19888	07309	27197	41
20	9.72823	9.92683	9.80140	10.19860	10.07317	10.27177	40
21	72843	92675	80168	19832	07325	27157	39
22	72863	92667	80195	19805	07333	27137	38
23	72883	92659	80223	19777	07341	27117	37
24	72902	92651	80251	19749	07349	27098	36
25	72922	92643	80279	19721	07357	27078	35
26	72942	92635	80307	19693	07365	27058	34
27	72962	92627	80335	19665	07373	27038	33
28	72982	92619	80363	19637	07381	27018	32
29	73002	92611	80391	19609	07389	26998	31
30	9.73022	9.92603	9.80419	10.19581	10.07397	10.26978	30
31	73041	92595	80447	19553	07405	26959	29
32	73061	92587	80474	19526	07413	26939	28
33	73081	92579	80502	19498	07421	26919	27
34	73101	92571	80530	19470	07429	26899	26
35	73121	92563	80558	19442	07437	26879	25
36	73140	92556	80585	19414	07445	26860	24
37	73160	92546	80614	19386	07454	26840	23
38	73180	92538	80642	19358	07462	26820	22
39	73200	92530	80669	19331	07470	26800	21
40	9.73219	9.92522	9.80697	10.19303	10.07478	10.26781	20
41	73239	92514	80725	19275	07486	26761	19
42	73259	92506	80753	19247	07494	26741	18
43	73278	92498	80781	19219	07502	26722	17
44	73298	92490	80808	19192	07510	26702	16
45	73318	92482	80836	19164	07518	26682	15
46	73337	92473	80864	19136	07527	26663	14
47	73357	92465	80892	19108	07535	26643	13
48	73377	92457	80919	19081	07543	26623	12
49	73396	92449	80947	19053	07551	26604	11
50	9.73416	9.92441	9.80975	10.19025	10.07559	10.26584	10
51	73435	92433	81003	18997	07567	26565	9
52	73455	92425	81030	18970	07575	26545	8
53	73474	92416	81058	18942	07584	26526	7
54	73494	92408	81086	18914	07592	26506	6
55	73513	92400	81113	18887	07600	26487	5
56	73533	92392	81141	18859	07608	26467	4
57	73552	92384	81169	18831	07616	26448	3
58	73572	92376	81196	18804	07624	26428	2
59	73591	92367	81224	18776	07633	26409	1
60	73611	92359	81252	18748	07641	26389	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M

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57 Degrees.

A Table of Artificial Sines, Tang. and Sec. 33 Degrees.

M.	Sine.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.73611	9.92359	9.81252	10.18748	10.07641	10.26389	60
1	73630	92351	81279	18721	07649	26370	59
2	73650	92343	81307	18693	07657	26350	58
3	73669	92334	81335	18665	07666	26331	57
4	73689	92326	81362	18638	07674	26311	56
5	73708	92318	81390	18610	07682	26292	55
6	73727	92310	81417	18582	07690	26273	54
7	73747	92302	81445	18555	07698	26253	53
8	73766	92293	81473	18527	07707	26234	52
9	73785	92285	81500	18500	07715	26215	51
10	9.73805	9.92277	9.81528	10.18472	10.07723	10.26195	50
11	73824	92269	81556	18444	07731	26176	49
12	73843	92260	81583	18417	07740	26157	48
13	73863	92252	81611	18389	07748	26137	47
14	73882	92244	81638	18362	07756	26118	46
15	73901	92235	81666	18334	07765	26099	45
16	73921	92227	81693	18307	07773	26079	44
17	73940	92219	81721	18279	07781	26060	43
18	73959	92211	81748	18252	07789	26041	42
19	73978	92202	81776	18224	07798	26022	41
20	9.73997	9.92194	9.81803	10.18197	10.07806	10.26002	40
21	74017	92186	81831	18169	07814	25983	39
22	74036	92177	81858	18142	07823	25964	38
23	74055	92169	81886	18114	07831	25945	37
24	74074	92161	81913	18087	07839	25926	36
25	74093	92152	81941	18059	07848	25907	35
26	74112	92144	81968	18032	07856	25887	34
27	74132	92136	81996	18004	07864	25868	33
28	74151	92127	82023	17977	07873	25849	32
29	74170	92119	82051	17949	07881	25830	31
30	9.74189	9.92111	9.82078	10.17922	10.07889	10.25811	30
31	74208	92102	82106	17894	07898	25792	29
32	74227	92094	82133	17867	07906	25773	28
33	74246	92086	82161	17839	07914	25754	27
34	74265	92077	82188	17812	07923	25735	26
35	74284	92069	82215	17784	07931	25716	25
36	74303	92060	82243	17757	07940	25697	24
37	74322	92052	82270	17730	07948	25678	23
38	74341	92044	82298	17702	07956	25659	22
39	74360	92035	82325	17675	07965	25640	21
40	9.74379	9.92027	9.82352	10.17648	10.07973	10.25621	20
41	74398	92018	82380	17620	07982	25602	19
42	74417	92010	82407	17593	07990	25583	18
43	74436	92002	82434	17565	07998	25564	17
44	74455	91993	82462	17538	08007	25545	16
45	74474	91985	82489	17511	08015	25526	15
46	74493	91976	82537	17483	08024	25507	14
47	74512	91968	82544	17456	08032	25488	13
48	74531	91959	82571	17429	08041	25469	12
49	74549	91951	82599	17401	08049	25451	11
50	9.74568	9.91942	9.82626	10.17374	10.08058	10.25432	10
51	74587	91934	82653	17347	08066	25413	9
52	74606	91925	82681	17319	08075	25394	8
53	74625	91917	82708	17292	08083	25375	7
54	74644	91908	82735	17265	08092	25356	6
55	74662	91900	82762	17238	08100	25338	5
56	74681	91891	82790	17210	08109	25319	4
57	74700	91883	82817	17183	08117	25300	3
58	74719	91874	82844	17156	08126	25281	2
59	74737	91866	82871	17129	08134	25263	1
60	74756	91857	82899	17101	08143	25244	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 34 Degrees.

M.	Sine.	Co Sine.	Tang.	Co. Tang.	Secant.	Co-secant.	
0	9.74756	91857	9.82899	10.17101	10.08143	10.25244	60
1	74775	91849	82926	17074	08151	25225	59
2	74794	91840	82953	17047	08160	25206	58
3	74812	91832	82980	17020	08168	25188	57
4	74831	91823	83008	16992	08177	25169	56
5	74850	91815	83035	16965	08185	25150	55
6	74868	91806	83062	16938	08194	25132	54
7	74887	91798	83089	16911	08202	25113	53
8	74906	91789	83116	16883	08211	25094	52
9	74924	91780	83144	16856	08219	25076	51
10	9.74943	9.91772	9.83171	10.16829	10.08228	10.25057	50
11	74961	91763	83198	16802	08237	25039	49
12	74980	91755	83225	16775	08245	25020	48
13	74999	91746	83252	16748	08254	25001	47
14	75017	91738	83279	16720	08262	24983	46
15	75036	91729	83307	16693	08271	24964	45
16	75054	91720	83334	16665	08280	24946	44
17	75073	91712	83361	16639	08288	24927	43
18	75091	91703	83388	16612	08297	24909	42
19	75110	91694	83415	16585	08305	24890	41
20	9.75128	9.91686	9.83442	10.16558	10.08314	10.24872	40
21	75147	91677	83470	16530	08323	24853	39
22	75165	91668	83497	16503	08331	24835	38
23	75184	91660	83524	16476	08340	24816	37
24	75202	91651	83551	16449	08349	24798	36
25	75221	91643	83578	16422	08357	24779	35
26	75239	91634	83605	16395	08366	24761	34
27	75258	91625	83632	16368	08375	24742	33
28	75276	91617	83659	16341	08383	24724	32
29	75294	91608	83686	16314	08392	24706	31
30	9.75313	9.91599	9.83713	10.16287	10.08401	10.24687	30
31	75331	91591	83740	16260	08409	24669	29
32	75349	91582	83767	16232	08418	24650	28
33	75368	91573	83795	16205	08427	24632	27
34	75386	91565	83822	16178	08435	24614	26
35	75405	91556	83840	16151	08444	24595	25
36	75423	91547	83876	16124	08453	24577	24
37	75441	91538	83903	16097	08462	24559	23
38	75459	91530	83930	16070	08470	24541	22
39	75478	91521	83957	16043	08479	24522	21
40	9.75496	9.91512	9.83984	10.16016	10.08488	10.24504	20
41	75514	91503	84011	15989	08496	24486	19
42	75533	91495	84038	15962	08505	24467	18
43	75551	91486	84065	15935	08514	24449	17
44	75569	91477	84092	15908	08523	24431	16
45	75587	91468	84119	15881	08531	24413	15
46	75605	91460	84146	15854	08540	24395	14
47	75624	91451	84173	15827	08549	24376	13
48	75642	91442	84200	15800	08558	24358	12
49	75660	91433	84227	15773	08567	24340	11
50	9.75678	9.91425	9.84254	10.15746	10.08575	10.24322	10
51	75696	91416	84280	15720	08584	24304	9
52	75714	91407	84307	15693	08593	24286	8
53	75732	91398	84334	15666	08602	24267	7
54	75751	91389	84361	15639	08611	24249	6
55	75769	91381	84388	15612	08619	24231	5
56	75787	91372	84415	15585	08628	24213	4
57	75805	91363	84442	15558	08637	24195	3
58	75823	91354	84469	15531	08646	24177	2
59	75841	91345	84496	15504	08655	24159	1
60	75859	91336	84523	15477	08664	24141	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 35 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-Tang.	Secant.	Co-secant	
0	9.75859	9.91336	9.84523	10.15477	10.08664	10.24141	60
1	75877	91328	84550	15450	08672	24123	59
2	75895	91319	84576	15424	08681	24105	58
3	75913	91310	84603	15397	08690	24087	57
4	75931	91301	84630	15370	08699	24069	56
5	75949	91292	84657	15343	08708	24051	55
6	75967	91283	84684	15316	08717	24033	54
7	75985	91274	84711	15289	08726	24015	53
8	76003	91267	84738	15262	08734	23997	52
9	76021	91257	84764	15236	08743	23979	51
10	9.76039	9.91248	9.84791	10.15209	10.08752	1.23961	50
11	76057	91239	84818	15182	08761	23943	49
12	76075	91230	84845	15155	08770	23925	48
13	76093	91221	84872	15128	08779	23907	47
14	76111	91212	84899	15101	08788	23889	46
15	76129	91203	84925	15075	08797	23871	45
16	76146	91194	84952	15048	08806	23854	44
17	76164	91185	84979	15021	08815	23836	43
18	76182	91176	85006	14994	08824	23818	42
19	76200	91167	85033	14967	08833	23800	41
20	9.76218	9.91158	9.85059	10.14941	10.08842	10.23782	40
21	76236	91149	85086	14914	08851	23764	39
22	76253	91141	85113	14887	08859	23747	38
23	76271	91132	85140	14860	08868	23729	37
24	76289	91123	85166	14834	08877	23711	36
25	76307	91114	85193	14807	08886	23693	35
26	76324	91105	85220	14780	08895	23676	34
27	76342	91096	85247	14753	08904	23658	33
28	76360	91087	85273	14727	08913	23640	32
29	76378	91078	85300	14700	08922	23622	31
30	9.76395	9.91069	9.85327	10.14673	10.08931	10.23605	30
31	76413	91060	85354	14646	08940	23587	29
32	76431	91051	85380	14620	08949	23569	28
33	76448	91042	85407	14593	08958	23552	27
34	76466	91034	85434	14566	08966	23534	26
35	76484	91025	85460	14540	08977	23516	25
36	76501	91014	85487	14513	08987	23499	24
37	76519	91005	85514	14486	08995	23481	23
38	76537	90996	85540	14460	09004	23463	22
39	76554	90987	85567	14433	09013	23446	21
40	9.76572	9.90978	9.85594	10.14406	10.09022	10.23428	20
41	76590	90969	85620	14380	09031	23410	19
42	76607	90960	85647	14353	09040	23393	18
43	76625	90951	85674	14326	09049	23375	17
44	76642	90942	85700	14300	09058	23358	16
45	76660	90933	85727	14273	09067	23340	15
46	76677	90924	85754	14246	09076	23323	14
47	76695	90915	85780	14220	09085	23305	13
48	76712	90905	85807	14193	09095	23288	12
49	76730	90896	85834	14166	09104	23270	11
50	9.76747	9.90887	9.85860	10.14140	10.09113	10.23253	10
51	76765	90878	85887	14113	09122	23235	9
52	76782	90869	85913	14087	09131	23218	8
53	76800	90860	85940	14060	09140	23200	7
54	76817	90851	85967	14033	09149	23183	6
55	76835	90842	85993	14007	09158	23165	5
56	76852	90832	86020	13980	09168	23148	4
57	76870	90823	86046	13954	09177	23130	3
58	76887	90814	86073	13927	09186	23113	2
59	76904	90805	86100	13900	09195	23096	1
60	76922	90896	76126	13874	09204	23078	0
Co-sine.	Sine.	Co tang.	Tang.	Co-secant.	Secant.	M.	

54 Degrees.

A Table of Artificial Sines, Tang. and Sec. 36 Degrees.

M.	Sine.	Co-sine.	Tangent	Co-tang.	Secant.	Co-secant.	
0	9.76922	9.90796	9.86126	10.13874	10.09204	10.23078	60
1	76939	90787	86153	13847	09213	23061	59
2	76957	90777	86179	13821	09223	23043	58
3	76974	90768	86206	13794	09232	23026	57
4	76991	90759	86232	13768	09241	23009	56
5	77009	90750	86259	13741	09250	22991	55
6	77026	90741	86285	13715	09259	22974	54
7	77043	90731	86312	13688	09269	22957	53
8	77061	90722	86338	13662	09278	22939	52
9	77078	90713	86365	13635	09287	22922	51
10	9.77095	9.90704	9.86392	10.13608	10.09296	10.22905	50
11	77112	90694	86418	13582	09306	22888	49
12	77130	90685	86445	13555	09315	22870	48
13	77147	90676	86471	13529	09324	22853	47
14	77164	90667	86496	13502	09333	22836	46
15	77181	90657	86524	13476	09343	22819	45
16	77199	90648	86551	13449	09352	22801	44
17	77216	90639	86577	13423	09361	22784	43
18	77233	90630	86603	13397	09370	22767	42
19	77250	90620	86630	13370	09380	22750	41
20	9.77268	9.90611	9.86656	10.13344	10.09389	10.22732	40
21	77285	90602	86683	13317	09398	22715	39
22	77302	90592	86709	13291	09408	22698	38
23	77319	90583	86736	13264	09417	22681	37
24	77336	90574	86762	13238	09426	22664	36
25	77353	90565	86789	13211	09435	22647	35
26	77370	90555	86815	13185	09445	22630	34
27	77387	90546	86842	13158	09454	22613	33
28	77405	90537	86868	13132	09463	22595	32
29	77422	90527	86894	13106	09473	22578	31
30	9.77439	9.90518	9.86921	10.13079	10.09482	10.22561	30
31	77456	90509	86947	13053	09491	22544	29
32	77473	90499	86974	13026	09501	22527	28
33	77490	90490	87000	13000	09510	22510	27
34	77507	90480	87027	12973	09520	22493	26
35	77524	90471	87053	12947	09529	22476	25
36	77541	90462	87079	12921	09538	22459	24
37	77558	90453	87106	12894	09548	22442	23
38	77575	90443	87132	12868	09557	22425	22
39	77592	90434	87158	12842	09566	22408	21
40	9.77609	9.90424	9.87185	10.12815	10.09576	10.22391	20
41	77626	90415	87211	12789	09585	22374	19
42	77643	90405	87238	12762	09595	22357	18
43	77660	90396	87264	12736	09604	22340	17
44	77677	90386	87290	12710	09613	22324	16
45	77694	90377	87317	12683	09623	22306	15
46	77711	90368	87343	12657	09632	22289	14
47	77727	90358	87369	12631	09642	22272	13
48	77744	90349	87396	12604	09651	22256	12
49	77761	90339	87422	12578	09661	22239	11
50	9.77778	9.90330	9.87448	10.12552	10.09670	10.22222	10
51	77795	90320	87475	12525	09680	22205	9
52	77812	90311	87501	12499	09689	22188	8
53	77829	90301	87527	12473	09699	22171	7
54	77846	90292	87554	12446	09708	22154	6
55	77862	90282	87580	12420	09718	22138	5
56	77879	90273	87606	12394	09727	22121	4
57	77896	90263	87633	12367	09737	22104	3
58	77913	90254	87659	12341	09746	22087	2
59	77930	90244	87685	12315	09756	22070	1
60	77946	90235	87711	12289	09765	22054	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 37 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.77946	9.90235	9.87711	10.12289	10.09765	10.22054	60
1	77963	90225	87738	12262	09775	22037	59
2	77980	90216	87764	12236	09784	22020	58
3	77997	90206	87790	12210	09794	22003	57
4	78013	90197	87817	12183	09803	21987	56
5	78030	90187	87843	12157	09813	21970	55
6	78047	90178	87869	12131	09822	21953	54
7	78063	90168	87895	12105	09832	21937	53
8	78080	90159	87922	12078	09841	21920	52
9	78097	90149	87948	12052	09851	21903	51
10	9.78113	9.90139	9.87974	10.12026	10.09861	10.21887	50
11	78130	90130	88000	12000	09870	21870	49
12	78147	90120	88027	11973	09880	21853	48
13	78163	90111	88053	11947	09889	21837	47
14	78180	90101	88079	11921	09899	21820	46
15	78197	90091	88105	11895	09909	21803	45
16	78213	90082	88131	11869	09918	21787	44
17	78230	90072	88158	11842	09928	21770	43
18	78246	90063	88184	11816	09937	21754	42
19	78263	90053	88210	11790	09947	21737	41
20	9.78280	9.90043	9.88236	10.11764	10.09957	10.21720	40
21	78296	90034	88262	11738	09966	21704	39
22	78313	90024	88289	11711	09976	21687	38
23	78329	90014	88315	11685	09986	21671	37
24	78346	90005	88341	11659	09995	21654	36
25	78362	89995	88367	11633	10005	21638	35
26	78379	89985	88393	11607	10015	21621	34
27	78395	89976	88420	11580	10024	21605	33
28	78412	89966	88446	11554	10034	21588	32
29	78428	89956	88472	11528	10044	21572	31
30	9.78445	9.89947	9.88498	10.11502	10.10053	10.21555	30
31	78461	89937	88524	11476	10063	21539	29
32	78478	89927	88550	11450	10073	21522	28
33	78494	89918	88576	11424	10082	21506	27
34	78510	89908	88603	11397	10092	21490	26
35	78527	89898	88629	11371	10102	21473	25
36	78543	89888	88655	11345	10112	21457	24
37	78560	89879	88681	11319	10121	21440	23
38	78576	89869	88707	11293	10131	21424	22
39	78592	89859	88733	11267	10141	21408	21
40	9.78609	9.89849	9.88759	10.11241	10.10151	10.21391	20
41	78625	89840	88786	11214	10160	21375	19
42	78642	89830	88812	11188	10170	21358	18
43	78658	89820	88838	11162	10180	21342	17
44	78674	89810	88864	11136	10190	21326	16
45	78691	89801	88890	11110	10199	21309	15
46	78707	89791	88916	11084	10209	21293	14
47	78723	89781	88942	11058	10219	21277	13
48	78730	89771	88968	11032	10229	21261	12
49	78756	89761	88994	11006	10239	21244	11
50	9.78772	9.89752	9.89220	10.10980	10.10248	10.21228	10
51	78778	89742	89046	10954	10258	21212	9
52	78805	89732	89073	10927	10268	21195	8
53	78821	89722	89099	10901	10278	21179	7
54	78837	89712	89125	10875	10288	21163	6
55	78853	89702	89151	10849	10298	21147	5
56	78869	89693	89177	10823	10307	21131	4
57	78886	89683	89203	10797	10317	21114	3
58	78902	89673	89229	10771	10327	21098	2
59	78918	89663	89255	10745	10337	21082	1
60	78934	89653	89281	10719	10347	21066	0
	Co fine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 38 Degrees.

M.	Sine.	Co-line	Tang.	Co-tang.	Secant.	Co-secant.	
0	9.78934	9.89653	9.89281	10.10719	10.10347	10.21066	60
1	78950	89643	89307	10693	10357	21050	59
2	78967	89633	89333	10667	10367	21033	58
3	78983	89624	89359	10641	10376	21017	57
4	78999	89614	89385	10615	10386	21001	56
5	79015	89604	89411	10589	10396	20985	55
6	79031	89594	89437	10563	10406	20969	54
7	79047	89584	89463	10537	10416	20953	53
8	79063	89574	89489	10511	10426	20937	52
9	79079	89564	89515	10485	10436	20921	51
10	9.79095	9.89554	9.89541	10.10459	10.10446	10.20905	50
11	79111	89544	89567	10433	10456	20889	49
12	79128	89534	89593	10407	10466	20872	48
13	79144	89524	89619	10381	10476	20856	47
14	79160	89514	89645	10355	10486	20840	46
15	79176	89504	89671	10329	10496	20824	45
16	79192	89495	89697	10303	10505	20808	44
17	79208	89485	89723	10277	10515	20792	43
18	79224	89475	89749	10251	10525	20776	42
19	79240	89465	89775	10225	10535	20760	41
20	9.79256	9.89455	9.89801	10.10199	10.10545	10.20744	40
21	79272	89445	89827	10173	10555	20728	39
22	79288	89435	89853	10147	10565	20712	38
23	79304	89425	89879	10121	10575	20696	37
24	79319	89415	89905	10095	10585	20681	36
25	79335	89405	89931	10069	10595	20665	35
26	79351	89395	89957	10043	10605	20649	34
27	79367	89385	89983	10017	10615	20633	33
28	79383	89375	90009	99991	10625	20617	32
29	79399	89364	90035	99965	10636	20601	31
30	9.79415	9.89354	9.90060	10.09939	10.10646	10.20585	30
31	79431	89344	90086	99914	10656	20569	29
32	79447	89334	90112	99888	10666	20553	28
33	79463	89324	90138	99862	10676	20537	27
34	79478	89314	90164	99836	10686	20522	26
35	79494	89304	90190	99810	10696	20506	25
36	79510	89294	90216	99784	10706	20490	24
37	79526	89284	90242	99758	10716	20474	23
38	79542	89274	90268	99732	10726	20458	22
39	79558	89264	90294	99706	10736	20442	21
40	9.79573	9.89251	9.90320	10.09680	10.10746	10.20427	20
41	79589	89244	90346	99654	10756	20411	19
42	79605	89233	90371	99629	10767	20395	18
43	79621	89223	90397	99603	10777	20379	17
44	79636	89213	90423	99577	10787	20364	16
45	79652	89203	90449	99551	10797	20348	15
46	79668	89193	90475	99525	10807	20332	14
47	79684	89183	90501	99499	10817	20316	13
48	79699	89173	90527	99473	10827	20301	12
49	79715	89162	90553	99447	10838	20285	11
50	9.79731	9.89152	9.90578	10.09422	10.10848	10.20269	10
51	79746	89142	90604	99396	10858	20254	9
52	79762	89132	90630	99370	10868	20238	8
53	79778	89122	90656	99344	10878	20222	7
54	79793	89112	90682	99318	10888	20207	6
55	79809	89101	90708	99292	10899	20191	5
56	79825	89091	90734	99266	10909	20175	4
57	79840	89081	90759	99241	10919	20160	3
58	79856	89071	90785	99215	10929	20144	2
59	79872	89060	90811	99189	10940	20128	1
60	79887	89050	90837	99163	10950	20113	0
	Co-line.	Sine	Co tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 39 Degrees.

M.	Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9.79887	9.89050	9.90837	10.09163	10.10950	10.20113	60
1	79903	89040	90863	09137	10960	20097	59
2	79918	89030	90889	09111	10970	20082	58
3	79934	89020	90914	09086	10980	20066	57
4	79950	89009	90940	09060	10991	20050	56
5	79965	88999	90966	09034	11001	20035	55
6	79981	88989	90992	09008	11011	20019	54
7	79996	88978	91018	08982	11022	20004	53
8	80012	88968	91043	08957	11032	20088	52
9	80027	88958	91060	08931	11042	20073	51
10	9.80043	9.88948	9.91095	10.08905	10.11052	10.19957	50
11	80058	88937	91121	08879	11063	19942	49
12	80074	88927	91147	08853	11073	19926	48
13	80089	88917	91172	08828	11083	19911	47
14	80105	88906	91198	08802	11094	19895	46
15	80120	88896	91224	08776	11104	19880	45
16	80136	88886	91250	08750	11114	19864	44
17	80151	88875	91276	08724	11125	19849	43
18	80166	88865	91301	08699	11135	19834	42
19	80182	88855	91327	08673	11145	19818	41
20	9.80197	9.88844	9.91353	10.08647	10.11156	10.19803	40
21	80213	88834	91379	08621	11166	19787	39
22	80228	88824	91404	08596	11176	19772	38
23	80244	88813	91430	08570	11187	19756	37
24	80259	88803	91456	08544	11197	19741	36
25	80274	88793	91482	08518	11207	19726	35
26	80290	88782	91507	08493	11218	19710	34
27	80305	88772	91533	08467	11228	19695	33
28	80320	88761	91559	08441	11239	19680	32
29	80336	88751	91585	08415	11249	19664	31
30	9.80351	9.88741	9.91610	10.08390	10.11259	10.19649	30
31	80366	88730	91636	08364	11270	19634	29
32	80382	88720	91662	08338	11280	19618	28
33	80397	88709	91688	08312	11291	19603	27
34	80412	88699	91713	08287	11301	19588	26
35	80428	88688	91739	08261	11312	19572	25
36	80443	88678	91765	08235	11322	19557	24
37	80458	88668	91791	08209	11332	19542	23
38	80473	88657	91816	08184	11343	19527	22
39	80489	88647	91842	08158	11353	19511	21
40	9.80504	9.88636	9.91868	10.08132	10.11364	10.19490	20
41	80519	88626	91893	08107	11374	19481	19
42	80534	88615	91919	08081	11385	19466	18
43	80550	88605	91945	08055	11395	19450	17
44	80565	88594	91971	08029	11406	19435	16
45	80580	88584	91996	08004	11416	19420	15
46	80595	88573	92022	07978	11427	19405	14
47	80610	88563	92048	07952	11437	19390	13
48	80625	88552	92073	07927	11448	19375	12
49	80641	88542	92099	07901	11458	19359	11
50	9.80656	9.88531	9.92125	10.07875	10.11469	10.19344	10
51	80671	88521	92150	07850	11479	19329	9
52	80686	88510	92176	07824	11490	19314	8
53	80701	88499	92202	07798	11501	19299	7
54	80716	88489	92227	07773	11511	19284	6
55	80731	88478	92253	07747	11522	19269	5
56	80746	88468	92279	07721	11532	19254	4
57	80762	88457	92304	07696	11543	19238	3
58	80777	88447	92330	07670	11553	19223	2
59	80792	88436	92356	07644	11564	19208	1
60	80807	88425	92381	07619	11575	19193	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

50 Degrees.

A Table of Artificial Sines, Tang. and Sec. 40 Degrees.

M.	Sine.	Co-line.	Tang.	Co-tang.	Secant.	Co-secant	
0	9.80807	9.88425	9.92381	10.07619	10.11575	10.19193	60
1	80822	88415	92407	07593	11585	19178	59
2	80837	88404	92433	07567	11596	19163	58
3	80852	88394	92458	07542	11606	19148	57
4	80867	88383	92484	07516	11617	19133	56
5	80882	88372	92510	07490	11628	19118	55
6	80897	88362	92535	07465	11638	19103	54
7	80912	88351	92561	07439	11649	19088	53
8	80927	88340	92587	07413	11660	19073	52
9	80942	88330	92612	07388	11670	19058	51
10	9.80957	9.88319	9.92638	10.07362	10.11681	10.19043	50
11	80972	88308	92663	07337	11692	19028	49
12	80987	88298	92689	07311	11702	19013	48
13	81002	88287	92715	07285	11713	18998	47
14	81017	88276	92740	07260	11724	18983	46
15	81032	88266	92766	07234	11734	18968	45
16	81046	88255	92792	07208	11745	18954	44
17	81061	88244	92817	07183	11756	18939	43
18	81076	88234	92843	07157	11766	18924	42
19	81091	88223	92868	07132	11777	18909	41
20	9.81106	9.88212	9.92894	10.07106	10.11788	10.18854	40
21	81121	88201	92920	07080	11799	18879	39
22	81136	88191	92945	07055	11809	18864	38
23	81151	88180	92971	07029	11820	18849	37
24	81166	88169	92996	07004	11831	18834	36
25	81180	88158	93022	07978	11842	18820	35
26	81195	88148	93048	07952	11852	18805	34
27	81210	88137	93073	07927	11863	18790	33
28	81225	88126	93099	07901	11874	18775	32
29	81240	88115	93124	07876	11885	18760	31
30	9.81254	9.88105	9.93150	10.06850	10.11895	10.18746	30
31	81269	88094	93175	06825	11906	18731	29
32	81284	88083	93201	06799	11917	18716	28
33	81299	88072	93227	06773	11928	18701	27
34	81314	88061	93252	06748	11939	18686	26
35	81328	88050	93278	06722	11949	18672	25
36	81343	88040	93303	06697	11960	18657	24
37	81358	88029	93329	06671	11971	18642	23
38	81372	88018	93354	06646	11982	18628	22
39	81387	88007	93380	06620	11993	18613	21
40	9.81402	9.87996	9.93406	10.06594	10.12004	10.18598	20
41	81417	87985	93431	06569	12015	18583	19
42	81431	87975	93457	06543	12025	18569	18
43	81446	87964	93482	06518	12036	18554	17
44	81461	87953	93508	06492	12047	18539	16
45	81475	87942	93533	06467	12058	18525	15
46	81490	87931	93559	06441	12069	18510	14
47	81505	87920	93584	06416	12080	18495	13
48	81519	87909	93610	06390	12091	18481	12
49	81534	87898	93635	06364	12102	18466	11
50	9.81549	9.87887	9.93661	10.06339	10.12112	10.18451	10
51	81563	87877	93687	06313	12128	18437	9
52	81573	87866	93712	06288	12134	18422	8
53	81592	87855	93738	06262	12145	18408	7
54	81607	87844	93763	06237	12156	18393	6
55	81622	87833	93789	06211	12167	18378	5
56	81636	87822	93814	06186	12178	18364	4
57	81651	87811	93840	06160	12189	18349	3
58	81665	87800	93865	06135	12200	18335	2
59	81680	87789	93891	06109	12211	18320	1
60	81694	87778	93916	06084	12222	18306	0
	Co-line.	Sine.	Co tang.	Tang.	Co-secant.	Secant.	MI.

A Table of Artificial Sines, Tang. and Sec. 41 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-Tang.	Secant.	Co-secant.	
0	9. 81694	9. 87778	9. 93916	10. 06084	10. 12222	10. 18306	60
1	81709	87767	93942	06058	12233	18291	59
2	81723	87756	93997	06033	12244	18277	58
3	81738	87745	93993	06007	12255	18262	57
4	81752	87734	94018	05982	12266	18248	56
5	81767	87723	94044	05956	12277	18233	55
6	81781	87712	94069	05931	12288	18219	54
7	81796	87701	94095	05905	12299	18204	53
8	81810	87690	94120	05880	12310	18190	52
9	81825	87679	94146	05854	12321	18175	51
10	9. 81839	9. 87668	9. 94171	10. 05829	10. 12332	10. 18161	50
11	81854	87657	94197	05803	12343	18146	49
12	81868	87646	94222	05778	12354	18132	48
13	81882	87635	94248	05752	12365	18118	47
14	81897	87624	94273	05727	12376	18103	46
15	81911	87613	94299	05701	12387	18089	45
16	81926	87601	94324	05676	12399	18074	44
17	81940	87590	94350	05650	12410	18060	43
18	81954	87579	94375	05625	12421	18046	42
19	81969	87568	94401	05599	12432	18031	41
20	9. 81983	9. 87557	9. 94426	10. 05574	10. 12443	10. 18017	40
21	81998	87546	94452	05548	12454	18002	39
22	82012	87535	94477	05523	12465	17988	38
23	82026	87524	94503	05497	12476	17974	37
24	82041	87513	94528	05472	12487	17959	36
25	82055	87501	94554	05446	12499	17945	35
26	82069	87490	94579	05421	12510	17931	34
27	82084	87479	94604	05396	12521	17916	33
28	82098	87468	94630	05370	12532	17902	32
29	82112	87457	94655	05345	12543	17888	31
30	9. 82126	9. 87446	9. 94681	10. 05319	10. 12554	10. 17874	30
31	82141	87434	94706	05294	12566	17859	29
32	82155	87423	94732	05268	12577	17845	28
33	82169	87412	94757	05243	12588	17831	27
34	82184	87401	94783	05217	12599	17816	26
35	82198	87390	94808	05192	12610	17802	25
36	82212	87378	94834	05166	12622	17788	24
37	82226	87367	94859	05141	12633	17774	23
38	82240	87356	94884	05116	12644	17760	22
39	82255	87345	94910	05090	12655	17745	21
40	9. 82269	9. 87334	9. 94935	10. 05065	10. 12666	10. 17731	20
41	82283	87322	94961	05039	12678	17717	19
42	82297	87311	94986	05014	12689	17703	18
43	82311	87300	95012	04988	12700	17689	17
44	82326	87288	95037	04963	12711	17674	16
45	82340	87277	95062	04938	12723	17660	15
46	82354	87266	95088	04912	12734	17646	14
47	82368	87255	95113	04887	12745	17632	13
48	82382	87243	95139	04861	12757	17618	12
49	82396	87232	95164	04836	12768	17604	11
50	9. 82410	9. 87221	9. 95190	10. 04810	10. 12779	10. 17590	10
51	82424	87209	95215	04760	12791	17576	9
52	82439	87198	95240	04760	12802	17561	8
53	82453	87187	95266	04734	12813	17547	7
54	82467	87175	95291	04709	12825	17533	6
55	82481	87164	95317	04683	12836	17519	5
56	82495	87153	95342	04658	12847	17505	4
57	82509	87141	95368	04632	12859	17491	3
58	82523	87130	95393	04607	12870	17477	2
59	82537	87119	95418	04582	12881	17463	1
60	82551	87107	95444	04556	12893	17449	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 42 Degrees.

M.	Sine.	Co-fine.	Tangent.	Co-tang.	Secant.	Co-secant	
0	9. 82551	9. 87107	9. 95444	10. 04556	10. 12893	10. 17449	60
1	82565	87096	95469	04531	12904	17435	59
2	82579	87085	95495	04505	12915	17421	58
3	82593	87073	95520	04480	12927	17407	57
4	82607	87062	95545	04455	12938	17393	56
5	82621	87050	95571	04429	12950	17379	55
6	82635	87039	95596	04404	12961	17365	54
7	82649	87028	95621	04378	12972	17351	53
8	82663	87016	95647	04353	12984	17337	52
9	82677	87005	95672	04328	12995	17323	51
10	9. 82691	9. 86993	9. 95698	10. 04302	10. 13007	10. 17309	50
11	82705	86982	95723	04277	13018	17295	49
12	82719	86970	95748	04252	13030	17281	48
13	82733	86959	95774	04226	13041	17267	47
14	82747	86947	95799	04201	13053	17253	46
15	82761	86936	95825	04175	13064	17239	45
16	82775	86924	95850	04150	13076	17226	44
17	82788	86913	95875	04125	13087	17212	43
18	82802	86902	95901	04099	13098	17198	42
19	82816	86890	95926	04074	13110	17184	41
20	9. 82830	9. 86879	9. 95952	10. 04048	10. 13121	10. 17170	40
21	82844	86867	95977	04023	13133	17156	39
22	82858	86855	96002	03998	13145	17142	38
23	82872	86844	96028	03972	13156	17128	37
24	82885	86832	96053	03947	13168	17115	36
25	82899	86821	96078	03922	13178	17101	35
26	82913	86809	96104	03896	13191	17087	34
27	82927	86798	96129	03871	13202	17073	33
28	82941	86786	96155	03845	13214	17059	32
29	82955	86775	96180	03820	13225	17045	31
30	9. 82968	9. 86763	9. 96205	10. 03795	10. 13237	10. 17032	30
31	82982	86752	96231	03769	13248	17018	29
32	82996	86740	96256	03744	13260	17004	28
33	83010	86728	96281	03719	13272	16990	27
34	83023	86717	96307	03693	13283	16977	26
35	83037	86705	96332	03668	13295	16963	25
36	83051	86694	96357	03643	13306	16949	24
37	83065	86682	96383	03617	13318	16935	23
38	83078	86670	96408	03592	13330	16922	22
39	83092	86659	96433	03567	13341	16908	21
40	9. 83106	9. 86647	9. 96459	10. 03541	10. 13353	10. 16894	20
41	83119	86635	96484	03516	13365	16880	19
42	83133	86624	96510	03490	13376	16867	18
43	83147	86612	96535	03465	13388	16853	17
44	83161	86600	96560	03440	13400	16839	16
45	83174	86589	96586	03414	13411	16826	15
46	83188	86577	96611	03389	13423	16812	14
47	83202	86565	96636	03364	13435	16798	13
48	83215	86554	96662	03338	13446	16785	12
49	83229	86542	96687	03313	13458	16771	11
50	9. 83242	9. 86530	9. 96712	10. 03288	10. 13470	10. 16758	10
51	83256	86518	96738	03262	13482	16744	9
52	83270	86507	96763	03237	13493	16730	8
53	83283	86495	96788	03212	13505	16717	7
54	83297	86483	96814	03186	13517	16703	6
55	83310	86472	96839	03161	13528	16690	5
56	83324	86460	96864	03136	13540	16676	4
57	83338	86448	96890	03110	13552	16662	3
58	83351	86436	96915	03085	13564	16649	2
59	83365	86425	96940	03060	13575	16635	1
60	83378	86413	96966	03034	13587	16622	0
	Co-fine.	Sine.	Co-tang	Tangent	Co-secant.	Secant.	M.

A Table of Artificial Sines, Tang. and Sec. 43 Degrees.

M.	Sine.	Co-sine.	Tangent	Co-tang.	Secant.	Co-secant	
0	9.83378	9.86413	9.96966	10.03034	10.13587	10.16622	60
1	83392	86401	96991	03009	13599	16608	59
2	83405	86389	97016	02984	13611	16595	58
3	83419	86377	97042	02958	13623	16581	57
4	83432	86366	97067	02933	13634	16568	56
5	83446	86354	97092	02908	13646	16554	55
6	83459	86342	97118	02882	13658	16541	54
7	83473	86330	97143	02857	13670	16527	53
8	83486	86318	97168	02832	13682	16513	52
9	83500	86306	97193	02807	13694	16500	51
10	9.83513	9.86295	9.97219	10.02781	10.13705	10.16487	50
11	83527	86283	97244	02756	13717	16473	49
12	83540	86271	97269	02731	13729	16460	48
13	83554	86259	97294	02705	13741	16446	47
14	83567	86247	97320	02680	13753	16433	46
15	83581	86235	97345	02655	13765	16419	45
16	83594	86223	97371	02629	13777	16406	44
17	83607	86211	97396	02604	13789	16392	43
18	83621	86200	97421	02579	13800	16379	42
19	83634	86188	97447	02553	13812	16366	41
20	9.83648	9.86176	9.97472	10.02528	10.13824	10.16352	40
21	83661	86164	97497	02503	13836	16339	39
22	83674	86152	97523	02477	13848	16326	38
23	83688	86140	97548	02452	13860	16312	37
24	83701	86128	97573	02427	13872	16299	36
25	83715	86116	97598	02402	13884	16285	35
26	83728	86104	97624	02376	13896	16272	34
27	83741	86092	97649	02351	13908	16259	33
28	83755	86080	97674	02326	13920	16245	32
29	83768	86068	97700	02300	13932	16232	31
30	9.83781	9.86056	9.97725	10.02275	10.13944	10.16219	30
31	83795	86044	97750	02250	13956	16205	29
32	83808	86032	97776	02224	13968	16192	28
33	83821	86020	97801	02199	13980	16179	27
34	83834	86008	97826	02174	13992	16166	26
35	83848	85996	97851	02149	14004	16152	25
36	83861	85984	97877	02123	14016	16139	24
37	83874	85972	97902	02098	14028	16126	23
38	83887	85960	97927	02073	14040	16113	22
39	83901	85948	97953	02047	14052	16099	21
40	9.83914	9.85936	9.97978	10.02022	10.14064	10.16086	20
41	83927	85924	98003	01997	14076	16073	19
42	83940	85912	98029	01971	14088	16060	18
43	83954	85900	98054	01946	14100	16046	17
44	83967	85888	98079	01921	14112	16033	16
45	83980	85876	98104	01896	14124	16020	15
46	83993	85864	98130	01870	14136	16007	14
47	84006	85851	98155	01845	14149	15994	13
48	84020	85839	98180	01820	14161	15980	12
49	84033	85827	98206	01794	14173	15967	11
50	9.84046	9.85815	9.98231	10.01769	10.14185	10.15954	10
51	84059	85803	98256	01744	14197	15941	9
52	84072	85791	98281	01719	14209	15928	8
53	84085	85779	98307	01693	14221	15915	7
54	84098	85766	98332	01668	14234	15902	6
55	84112	85754	98357	01643	14246	15888	5
56	84125	85742	98383	01617	14258	15875	4
57	84138	85730	98408	01592	14270	15862	3
58	84151	85718	98433	01567	14282	15849	2
59	84164	85706	98458	01542	14294	15836	1
60	84177	85693	98484	01516	14307	15823	0
	Co-line.	Sine.	Co-tang.	Tangent.	Co-secant.	Secant.	M.

46 Degrees.

A Table of Artificial Sines, Tang. and Sec. 44 Degrees.

M.	Sine.	Co-sine.	Tang.	Co-Tang.	Secant.	Co-secant.	
0	9.84177	9.85693	9.98484	10.01516	10.14307	10.15823	60
1	84190	85681	98509	01491	14319	15810	59
2	84203	85669	98534	01466	14331	15797	58
3	84216	85657	98560	01440	14343	15784	57
4	84229	85645	98585	01415	14355	15771	56
5	84242	85632	98610	01390	14368	15758	55
6	84255	85620	98635	01365	14380	15745	54
7	84269	85608	98661	01339	14392	15731	53
8	84282	85596	98686	01314	14404	15718	52
9	84295	85583	98711	01289	14417	15705	51
10	9.84308	9.85571	9.98737	10.01263	10.14429	10.15692	50
11	84321	85559	98762	01238	14441	15679	49
12	84334	85546	98787	01213	14454	15666	48
13	84347	85534	98812	01188	14466	15653	47
14	84360	85522	98838	01162	14478	15640	46
15	84372	85510	98863	01137	14490	15628	45
16	84385	85497	98888	01112	14503	15614	44
17	84398	85485	98913	01087	14515	15602	43
18	84411	85473	98939	01061	14527	15589	42
19	84424	85460	98964	01036	14540	15576	41
20	9.84437	9.85448	9.98989	10.01011	10.14552	10.15563	40
21	84450	85436	99014	00985	14564	15550	39
22	84463	85423	99040	00960	14577	15537	38
23	84476	85411	99065	00935	14589	15524	37
24	84489	85399	99090	00910	14601	15511	36
25	84502	85386	99116	00884	14614	15498	35
26	84515	85374	99141	00859	14626	15485	34
27	84528	85361	99166	00834	14639	15472	33
28	84540	85349	99191	00809	14651	15460	32
29	84553	85337	99217	00783	14663	15447	31
30	9.84566	9.85324	9.99242	10.00758	10.14676	10.15434	30
31	84579	85312	99267	00733	14688	15421	29
32	84592	85299	99293	00707	14701	15408	28
33	84605	85287	99318	00682	14713	15395	27
34	84618	85274	99343	00657	14726	15382	26
35	84630	85262	99368	00632	14738	15370	25
36	84643	85250	99394	00606	14750	15357	24
37	84656	85237	99419	00581	14763	15344	23
38	84669	85225	99444	00556	14775	15331	22
39	84682	85212	99469	00531	14788	15318	21
40	9.84694	9.85200	9.99495	10.00505	10.14800	10.15306	20
41	84707	85187	99520	00480	14813	15293	19
42	84720	85175	99545	00455	14825	15280	18
43	84733	85162	99570	00430	14838	15267	17
44	84745	85150	99596	00404	14850	15255	16
45	84758	85137	99621	00379	14863	15242	15
46	84771	85125	99646	00354	14875	15229	14
47	84784	85112	99672	00328	14888	15216	13
48	84796	85100	99697	00303	14900	15204	12
49	84809	85087	99722	00278	14913	15191	11
50	9.84822	9.85074	9.99747	10.00253	10.14926	10.15178	10
51	84834	85062	99773	00227	14938	15166	9
52	84847	85049	99798	00202	14951	15153	8
53	84860	85037	99823	00177	14963	15140	7
54	84873	85024	99848	00152	14976	15127	6
55	84885	85012	99874	00126	14988	15115	5
56	84898	84999	99899	00101	15001	15102	4
57	84911	84986	99924	00076	15014	15089	3
58	84923	84974	99949	00051	15026	15077	2
59	84936	84961	99975	00025	15039	15064	1
60	84948	84948	1000000	10.00000	15052	15051	0
	Co-sine.	Sine.	Co-tang.	Tangent.	Co-secant	Secant.	M

45 Degrees.

A TABLE of the SUN'S RIGHT ASCENSION.

Days	Jan.	Feb.	Marc.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days
	South	South	South	North	North	North	North	North	North	South	South	South	
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	
1	18 48	21 0	22 49	0 43	2 34	4 36	6 41	8 46	10 42	12 30	14 26	16 30	1
2	18 52	21 4	22 53	0 46	2 38	4 41	6 45	8 49	10 45	12 33	14 30	16 34	2
3	18 57	21 8	22 57	0 50	2 41	4 45	6 49	8 53	10 49	12 37	14 34	16 39	3
4	19 1	21 12	23 1	0 53	2 45	4 49	6 53	8 57	10 52	12 41	14 38	16 43	4
5	19 6	21 16	23 4	0 57	2 49	4 53	6 57	9 1	10 56	12 44	14 42	16 47	5
6	19 10	21 20	23 8	1 2	2 53	4 56	7 1	9 5	11 0	12 48	14 46	16 52	6
7	19 14	21 24	23 11	1 4	2 57	5 1	7 5	9 9	11 3	12 52	14 50	16 56	7
8	19 19	21 28	23 15	1 8	3 1	5 5	7 10	9 12	11 7	12 55	14 54	17 0	8
9	19 23	21 32	23 19	1 12	3 5	5 9	7 14	9 16	11 11	12 59	14 58	17 5	9
10	19 27	21 36	23 22	1 15	3 8	5 13	7 18	9 20	11 14	12 3	15 2	17 9	10
11	19 32	21 40	23 26	1 19	3 12	5 18	7 22	9 24	11 18	13 6	15 6	17 14	11
12	19 36	21 44	23 30	1 23	3 16	5 22	7 26	9 28	11 21	13 10	15 10	17 18	12
13	19 40	21 48	23 33	1 26	3 20	5 26	7 30	9 31	11 25	13 14	15 14	17 23	13
14	19 45	21 52	23 37	1 30	3 24	5 30	7 34	9 35	11 28	13 17	15 18	17 27	14
15	19 49	21 56	23 41	1 34	3 28	5 34	7 38	9 39	11 32	13 21	15 22	17 31	15
16	19 53	22 0	23 44	1 37	3 32	5 38	7 42	9 43	11 36	13 25	15 26	17 36	16
17	19 58	22 4	23 48	1 41	3 36	5 43	7 46	9 46	11 39	13 29	15 31	17 40	17
18	20 2	22 7	23 52	1 45	3 40	5 47	7 50	9 50	11 43	13 32	15 35	17 45	18
19	20 6	22 11	23 55	1 49	3 44	5 51	7 54	9 54	11 46	13 36	15 39	17 49	19
20	20 10	22 15	23 59	1 52	3 48	5 55	7 58	9 58	11 50	13 40	15 43	17 54	20
21	20 14	22 19	0 3	1 56	3 52	5 59	8 2	10 1	11 54	13 44	15 47	17 58	21
22	20 19	22 23	0 6	2 0	3 56	6 3	8 6	10 5	11 57	13 47	15 52	18 2	22
23	20 23	22 26	0 10	2 3	4 0	6 7	8 10	10 9	12 1	13 51	15 56	18 7	23
24	20 27	22 30	0 13	2 7	4 4	6 12	8 14	10 12	12 4	13 55	16 0	18 11	24
25	20 31	22 34	0 17	2 11	4 8	6 16	8 18	10 16	12 8	13 59	16 4	18 16	25
26	20 35	22 38	0 21	2 15	4 12	6 20	8 22	10 20	12 12	14 3	16 9	18 20	26
27	20 40	22 42	0 24	2 19	4 16	6 24	8 26	10 23	12 15	14 7	16 13	18 25	27
28	20 44	22 45	0 28	2 22	4 20	6 28	8 30	10 27	12 19	14 10	16 17	18 29	28
29	20 48		0 32	2 26	4 24	6 32	8 34	10 31	12 22	14 14	16 21	18 34	29
30	20 52		0 35	2 30	4 28	6 37	8 38	10 34	12 26	14 18	16 26	18 38	30
31	20 56		0 39		4 32		8 42	10 38		14 22		18 42	31

This Table is sufficiently exact for finding, when any Star comes to the Meridian, in order to obtain the Latitude; but in all Calculations for determining the Longitude by Celestial Observations, the Sun's Right Ascension and Declination must be taken out of the Nautical Almanac, as they are there calculated to a greater Degree of Accuracy.

A TABLE of the Right Ascension and Declination of some of the principal fixed Stars adapted to the Year 1779, with their Annual Variation.

Names of the Stars.	Right Ascen. in Time.				Ann. Vari.	Declination.				Ann. Vari.			
	H.	M.	S.	T.		S.	T.	°	'		''		
Arietis	1	54	45	2	3	337	22	24	34	2	N	17	64+
Aldebaran, South Eye of the Bull	4	23	15	5	3	427	16	2	57	9	N	8	32+
Pollux, Southern Twin	7	30	17	4	3	751	28	32	36	5	N	7	72-
Regulus, the Lion's Heart	9	55	17	8	3	24	13	2	23	6	N	17	17-
Spica Virginis	13	13	34	8	3	151	10	0	4	6	S.	18	97+
Antares, the Scorpion's Heart	16	15	53	6	3	661	25	55	22	9	S.	8	89+
Altair in Aquila, the Eagle	19	39	56	6	2	902	8	17	44	6	N	8	40+
Capricorn	20	5	6	6	3	346	13	12	55	4	S.	10	40-
Fomalhaut, in the Mouth of Southern Fish	22	44	3	2	3	378	30	47	13	6	S.	18	97-
Pegasi Markab	22	53	46	1	2	983	14	1	10	8	N	19	20+
Pegasi Algenib, in the Wing	0	1	52	8	3	08	13	57	7	8	N	20	4+
Ceti	2	50	45	0	3	128	3	12	41	7	N	14	80+
Capella, in Left Shoulder of Auriga	5	0	21	1	4	402	45	44	42	3	N	5	28+
Rigel, in the Foot of Orion	5	2	46	2	2	887	8	28	16	1	S.	4	94-
Taurus	5	12	20	4	3	786	28	24	8	5	N	4	24+
Orion, in the East Shoulder	5	43	12	8	3	250	7	20	46	6	N	1	56+
Sirius, in Great Dog's Mouth	6	35	25	5	2	690	16	25	5	3	S.	3	10+
Castor, in Head Southern Twin	7	18	55	6	3	876	32	21	14	8	N	6	80-
Procyon, in the Little Dog	7	26	27	7	3	205	5	47	3	4	N	7	42-
Arcturus in Bootes	14	4	29	4	2	821	20	21	5	9	N	17	16-
Sagittarius	18	7	54	9	3	930	34	27	55	9	S.	0	72-
Schedar in the Breast of Cassiopea	0	28	3	2	3	300	55	19	18		N	20	+
Pole Star in the Tail of the Little Bear	0	47	35	0	1	500	88	7	30		N	19	+
Achernar, in the River Eridanus	1	28	20	9	2	26	56	21	56		S.	18	+
Almaack, in the Foot of Andromeda	1	50	24	4	3	61	41	15	38		N	18	+
Algol in the Head of Medusa	2	54	11	3	3	84	40	5	24		N	15	+
Pleiades, or Seven Stars in the Neck of the Bull	3	34	21	2	3	54	23	24	24		N	12	+
Canopus, in Poop of Ship Argo	6	19	2	3	1	34	52	34	55		S.	2	+
Cor Hydrae, or Alphard	9	16	43	8	1	96	7	42	30		S.	15	+
Dubbe, the North Pointer in the Great Bear	10	47	58	4	3	89	62	56	22		N	19	-
South Star of Crofiers, Foot of the Crofs	12	14	29	8	3	22	61	52	27		S.	10	+
The West Foot of Centaur	14	24	57	6	4	41	59	54	59		S.	16	+
The Head of Andromeda	23	57	2	4	3	6	27	52	13		N	20	+
Lyra, the Bright Star in the Harp	18	29	27	0	2	0	38	35	13		N	2	+
Eridani	1	29	1	9	2	26	58	32	22		S.	18	+
Coronæ	15	24	41	0	2	0	27	28	17		N	12	-
Mirach, in Andromeda's Girdle	0	57	23	1	3	29	34	26	37		N	19	+
Bright Star in Oars of Ship Argo	9	10	43	0	0	75	68	48	53		S.	15	+
Southern Scale of Libra	14	38	50	2	3	30	15	7	39		S.	10	+
Northern Scale of Libra	15	5	17	2	3	30	8	33	59		S.	14	+
The Bright Star in Perseus	3	8	38	7	4	19	49	3	26		N	14	+

The First Ten Stars are used in the Nautical Almanac for determining the Longitude deduced from Doctor Bradley's Observations. All the Stars Right Ascensions are here reduced into Time, it being omitted in the Ephemeris for 1767.

It is obvious, that by the Sun's Annual Motion, he is perpetually changing his Declination and Right Ascension, which is set down in the preceding Table for the Noon of every Day at London; and may be reduced to any other Time or Meridian, as has been already shewn in finding the Longitude.

By the Procession of the Equinoxes, the fixed Stars are continually altering their Longitudes, Right Ascensions, and Declinations, the Alteration in Longitude is about 50 Seconds every Year; the Alteration in Right Ascension and Declination of some of the principal fixed Stars are set down in the preceding Table for 1779: and their Annual Variation, which being applied to the Right Ascension and Declination in the Table, by Addition or Subtraction, gives the Right Ascension and Declination for any succeeding Years.

The Right Ascension of the Sun, Moon, or Stars, is the Number of Degrees of the Equinoctial that comes to the Meridian with them, counted from the first Point of Aries.

The Use of the Tables of the Right Ascension of the Sun and Stars is to find the Time when any Star culminates, or is upon the Meridian on a given Day.

R U L E.

Look for the Right Ascension of the Sun and Star in the preceding Table, and subtract the Sun's Right Ascension from the Star's; but if the Sun's Right Ascension be greatest, add 24 Hours to the Star's Right Ascension, and then subtract the Sun's from it, the Remainder will be the Time of the Star's coming to the Meridian.

When the Sun's Right Ascension is least, the Star comes to the Meridian in the Afternoon, but before Noon when the Sun's is greatest.

E X A M P L E I.

At what Time will the Star Arcturus be on the Meridian of London, Dec. 1?

Arcturus's Right Ascension	H. M.
14 4	
24 0	
38 4	
Sun's Right Ascension	16 30
After Midnight	21 34
	12 0
Morning	9 34

That is, the Star Arcturus will be upon the Meridian of London 34 Minutes after Nine o'Clock in the Morning.

E X A M P L E II.

At what Time will the Star Virgin's Spike be on the Meridian of London, September 1?

Spica's Virginis's Right Ascension	H. M.
13 13	
Sun's Right Ascension	10 42
The Star culminates Afternoon	2 31

So the Star Virgin's Spike comes to the Meridian at London 31 Minutes after Two in the Afternoon.

To find what Star will come upon the Meridian at any given Time.

R U L E.

Add the Time from Noon to the Right Ascension of the Sun, the Sun will be the Right Ascension of the Star required to be known; with which enter the Table of the Star's Right Ascension, and find what Star's Right Ascension agrees with, or comes the nearest to it, and that is the Star required.

E X A M P L E I.

I would know what Star would be on the Meridian of London about Ten at Night, January 25?

Sun's Right Ascen. Jan. 25, at Noon	H. M.
20 31	
And for 10 Hours more	0 2
Given Time 10 Hours P. M.	10 0
	30 33
Sub.	24 0

Nearly answers to Sirius 6 33

E X A M P L E II.

What Star will be upon the Meridian of London 20 Minutes past Four in the Morning, May 10?

Sun's Right Ascen. May 9 at Noon	H. M.
3 5	
And for 16 Hours more	0 3
Given Time 16h. 30m. P. M.	16 30
Right Ascension of Mid Heaven	19 38

Answers nearly to Aquila

A TABLE of the SUN'S DECLINATION,

For the YEARS 1783, 1787, 1791, 1795, 1899,
1803, 1807.

Being the Third after Leap-Year.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	South	South	North	North	North	North	North	North	South	South	South
1	23. 0	17. 3	7. 30	4. 37	15. 8	22. 5	23. 8	18. 2	8. 26	3. 14	14. 30	21. 52
2	22. 55	16. 45	7. 7	5. 0	15. 26	22. 13	23. 4	17. 46	7. 54	3. 38	14. 50	22. 1
3	22. 49	16. 28	6. 44	5. 23	15. 43	22. 21	22. 59	17. 31	7. 32	4. 1	15. 8	22. 10
4	22. 43	16. 10	6. 21	5. 46	16. 1	22. 28	22. 54	17. 15	7. 10	4. 24	15. 27	22. 18
5	22. 36	15. 51	5. 58	6. 8	16. 18	22. 35	22. 49	16. 59	6. 47	4. 48	15. 45	22. 26
6	22. 29	15. 33	5. 35	6. 31	16. 35	22. 41	22. 43	16. 42	6. 25	5. 11	16. 4	22. 33
7	22. 22	15. 14	5. 12	6. 54	16. 52	22. 47	22. 37	16. 26	6. 2	5. 34	16. 21	22. 40
8	22. 14	14. 55	4. 48	7. 16	17. 8	22. 53	22. 30	16. 9	5. 40	5. 57	16. 39	22. 46
9	22. 5	14. 36	4. 25	7. 39	17. 24	22. 58	22. 23	15. 51	5. 17	6. 20	16. 56	22. 52
10	21. 56	14. 17	4. 1	8. 1	17. 40	23. 3	22. 16	15. 34	5. 54	6. 42	17. 13	22. 58
11	21. 47	13. 57	3. 38	8. 23	17. 55	23. 7	22. 8	15. 16	4. 32	7. 5	17. 30	23. 3
12	21. 37	13. 37	3. 14	8. 45	18. 11	23. 11	22. 0	14. 58	4. 8	7. 28	17. 46	23. 7
13	21. 27	13. 17	2. 51	9. 7	18. 26	23. 15	21. 51	14. 40	3. 46	7. 50	18. 2	23. 12
14	21. 17	12. 57	2. 27	9. 28	18. 40	23. 18	21. 42	14. 22	3. 23	8. 13	18. 18	23. 15
15	21. 6	12. 36	2. 3	9. 50	18. 54	23. 20	21. 33	14. 3	3. 0	8. 35	18. 34	23. 19
16	20. 54	12. 15	1. 40	10. 11	19. 8	23. 23	21. 23	13. 44	2. 36	8. 57	18. 49	23. 21
17	20. 43	11. 54	1. 16	10. 32	19. 22	23. 25	21. 13	13. 25	2. 13	9. 19	19. 4	23. 24
18	20. 30	11. 33	0. 52	10. 53	19. 35	23. 26	21. 3	13. 6	1. 50	9. 41	19. 18	23. 25
19	20. 18	11. 12	0. 29	11. 14	19. 48	23. 27	20. 52	12. 46	1. 27	10. 3	19. 32	23. 27
20	20. 5	10. 56	0. 5	11. 34	20. 1	23. 28	20. 41	12. 27	1. 3	10. 25	19. 46	23. 28
21	19. 52	10. 29	0. 29 N	11. 55	20. 13	23. 28	20. 29	12. 7	0. 40	10. 46	19. 59	23. 28
22	19. 38	10. 7	0. 42	12. 15	20. 25	23. 28	20. 18	11. 46	0. 16	11. 7	20. 12	23. 28
23	19. 24	9. 45	1. 6	12. 35	20. 37	23. 27	20. 6	11. 26	So. 7	11. 29	20. 25	23. 28
24	19. 10	9. 23	1. 30	12. 55	20. 48	23. 27	19. 53	11. 6	0. 31	11. 50	20. 37	23. 27
25	18. 55	9. 1	1. 53	13. 15	20. 59	23. 25	19. 40	10. 45	0. 54	12. 10	20. 49	23. 25
26	18. 40	8. 38	2. 17	13. 34	21. 10	23. 23	19. 27	10. 24	1. 17	12. 31	21. 1	23. 23
27	18. 25	8. 16	2. 40	13. 53	21. 20	23. 21	19. 14	10. 3	1. 41	12. 51	21. 12	23. 21
28	18. 9	7. 53	3. 4	14. 12	21. 30	23. 18	19. 0	9. 42	2. 4	13. 12	21. 22	23. 18
29	17. 53		3. 27	14. 31	21. 39	23. 15	18. 46	9. 20	2. 28	13. 32	21. 33	23. 14
30	17. 36		3. 0	14. 49	21. 48	23. 12	18. 31	8. 59	2. 51	13. 52	21. 43	23. 11
31	17. 19		4. 14		21. 57		18. 17	8. 37		14. 11		23. 5

A TABLE of the SUN'S DECLINATION,
For the YEARS 1784, 1788, 1792, 1796, 1800, 1804,
1808.

Each being Leap-Year.

Days	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	South	South	North	North	North	North	North	North	South	South	South
1	23. 2	17. 7	7. 13	4. 54	15. 21	22. 11	23. 5	17. 50	7. 59	3. 32	14. 45	21. 50
2	22. 56	16. 49	6. 50	5. 17	15. 39	22. 19	23. 0	17. 35	7. 37	3. 55	15. 4	22. 7
3	22. 51	16. 32	6. 27	5. 40	15. 54	22. 26	22. 55	17. 19	7. 15	4. 19	15. 22	22. 10
4	22. 45	16. 14	6. 4	6. 3	16. 11	22. 33	22. 50	17. 3	6. 53	4. 42	15. 41	22. 24
5	22. 38	15. 56	5. 41	6. 26	16. 37	22. 40	22. 44	16. 46	6. 30	5. 5	15. 59	22. 31
6	22. 31	15. 38	5. 17	6. 48	16. 48	22. 46	22. 38	16. 30	6. 8	5. 28	16. 17	22. 3
7	22. 24	15. 19	4. 54	7. 11	17. 4	22. 51	22. 32	16. 15	5. 45	5. 51	16. 35	22. 45
8	22. 16	15. 0	4. 31	7. 33	17. 20	22. 57	22. 25	15. 50	5. 23	6. 14	16. 52	22. 5
9	22. 7	14. 41	4. 7	7. 55	17. 36	23. 2	22. 17	15. 38	5.	6. 37	17. 9	22. 51
10	21. 59	14. 22	3. 44	8. 17	17. 52	23. 6	22. 9	15. 21	4. 37	7. 0	17. 26	23. 2
11	21. 49	14. 2	3. 20	8. 39	18. 7	23. 10	22. 1	15. 3	4. 14	7. 22	17. 42	23. 6
12	21. 40	13. 42	2. 56	9. 1	18. 22	23. 14	21. 53	14. 45	3. 51	7. 45	17. 59	23. 11
13	21. 30	13. 22	2. 33	9. 23	18. 37	23. 17	21. 44	14. 26	3. 28	8. 7	18. 14	23. 14
14	21. 19	13. 2	2. 9	9. 44	18. 51	23. 20	21. 35	14. 8	3. 5	8. 30	18. 30	23. 17
15	21. 8	12. 41	1. 45	10. 6	19. 5	23. 22	21. 25	13. 49	2. 42	8. 52	18. 45	23. 2
16	20. 57	12. 20	1. 22	10. 27	19. 19	23. 24	21. 15	13. 30	2. 19	9. 14	19. 0	23. 2
17	20. 46	11. 59	0. 58	10. 48	19. 32	23. 26	21. 5	13. 10	1. 55	9. 36	19. 15	23. 2
18	20. 33	11. 38	0. 34	11. 9	19. 45	23. 27	20. 54	12. 51	1. 32	9. 57	19. 29	23. 2
19	20. 21	11. 17	0. 11	11. 30	19. 58	23. 28	20. 43	12. 31	1. 9	10. 19	19. 43	23. 2
20	20. 8	10. 56	0. 13 N	11. 50	20. 11	23. 28	20. 32	12. 11	0. 45	10. 41	19. 56	23. 2
21	19. 55	10. 34	0. 37	12. 10	20. 23	23. 28	20. 20	11. 51	0. 22	11. 2	20. 9	23. 2
22	19. 41	10. 12	1. 0	12. 30	20. 34	23. 28	20. 8	11. 31	0. 15	11. 24	20. 22	23. 2
23	19. 27	9. 50	1. 24	12. 50	20. 46	23. 27	19. 56	11. 10	0. 25	11. 45	20. 34	23. 2
24	19. 13	9. 28	1. 48	13. 10	20. 57	23. 25	19. 43	10. 50	0. 48	12. 5	20. 46	23. 2
25	18. 58	9. 6	2. 11	13. 29	21. 7	23. 24	19. 30	10. 29	1. 12	12. 26	20. 58	23. 2
26	18. 43	8. 44	2. 35	13. 40	21. 18	23. 22	19. 17	10. 8	1. 35	12. 47	21. 0	23. 2
27	18. 28	8. 21	2. 58	14. 8	21. 27	23. 19	19. 3	9. 47	1. 59	13. 7	21. 20	23. 1
28	18. 12	7. 58	3. 21	14. 26	21. 37	23. 16	18. 49	9. 26	2. 22	13. 27	21. 30	23. 1
29	17. 56	7. 36	3. 45	14. 45	21. 46	23. 13	18. 35	9. 4	2. 45	13. 47	21. 40	23. 1
30	17. 4		4. 8	15. 3	21. 55	23. 9	18. 20	8. 43	3. 9	14. 6	21. 50	23. 7
31	17. 23		4. 31		22. 3		18. 5	8. 21		14. 26		23.

A TABLE of the SUN'S DECLINATION,

For the YEARS 1785, 1789, 1793, 1797, 1801,
1805, 1809.

Each being first after Leap-Year.

	Jan.	Feb.	Marc.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Days	South	South	South	North	North	North	North	North	North	South	South	South
1	22. 58	16. 54	7. 18	4. 49	15. 17	22. 9	23. 6	17. 54	8. 4	3. 27	14. 40	21. 57
2	22. 52	16. 36	6. 56	5. 12	15. 35	22. 17	23. 1	17. 38	7. 42	3. 40	14. 59	22. 6
3	22. 46	16. 18	6. 33	5. 35	15. 52	22. 25	22. 57	17. 23	7. 21	4. 13	15. 18	22. 14
4	22. 40	16. 0	6. 9	5. 57	16. 10	22. 32	22. 51	17. 7	6. 58	4. 36	15. 37	22. 22
5	22. 33	15. 42	5. 46	6. 20	16. 27	22. 38	22. 46	16. 50	6. 36	5. 0	15. 55	22. 29
6	22. 26	15. 23	5. 23	6. 43	16. 44	22. 44	22. 40	16. 34	6. 13	5. 23	16. 13	22. 37
7	22. 18	15. 5	5. 0	7. 5	17. 0	22. 50	22. 33	16. 17	5. 51	5. 46	16. 31	22. 43
8	22. 9	14. 46	4. 36	7. 28	17. 16	22. 55	22. 26	16. 0	5. 28	6. 9	16. 48	22. 49
9	22. 1	14. 26	4. 13	7. 50	17. 32	23. 0	22. 19	15. 42	5. 5	6. 31	17. 5	22. 55
10	21. 52	14. 7	3. 40	8. 12	17. 48	23. 5	22. 11	15. 25	4. 43	6. 54	17. 22	23. 0
11	21. 42	13. 47	3. 26	8. 34	18. 3	23. 9	22. 3	15. 7	4. 20	7. 17	17. 38	23. 5
12	21. 32	13. 27	3. 2	8. 56	18. 19	23. 13	21. 55	14. 49	3. 57	7. 40	17. 55	23. 10
13	21. 22	13. 6	2. 38	9. 18	18. 33	23. 16	21. 46	14. 31	3. 34	8. 2	18. 11	23. 14
14	21. 11	12. 46	2. 15	9. 39	18. 48	23. 19	21. 37	14. 12	3. 11	8. 24	18. 26	23. 17
15	21. 0	12. 26	1. 51	10. 1	19. 2	23. 22	21. 28	13. 53	2. 47	8. 47	18. 42	23. 20
16	20. 48	12. 4	1. 27	10. 22	19. 16	23. 24	21. 18	13. 34	2. 24	9. 9	18. 56	23. 23
17	20. 36	11. 42	1. 4	10. 43	19. 29	23. 26	21. 8	13. 15	2. 1	9. 31	19. 11	23. 25
18	20. 24	11. 22	0. 40	11. 4	19. 42	23. 27	20. 57	12. 56	1. 38	9. 52	19. 25	23. 26
19	20. 11	11. 1	0. 16	11. 25	19. 55	23. 28	20. 46	12. 36	1. 14	10. 14	19. 39	23. 27
20	19. 58	10. 39	0. 7 N	11. 45	20. 8	23. 28	20. 35	12. 16	0. 51	10. 36	19. 53	23. 28
21	19. 45	10. 17	0. 31	12. 5	20. 20	23. 28	20. 23	11. 56	0. 28	10. 57	20. 6	23. 28
22	19. 31	9. 56	0. 55	12. 26	20. 31	23. 28	20. 11	11. 36	0. 4	11. 18	20. 19	23. 28
23	19. 17	9. 34	1. 18	12. 46	20. 43	23. 27	19. 59	11. 15	0. 19 S.	11. 40	20. 31	23. 27
24	19. 2	9. 11	1. 42	13. 5	20. 54	23. 26	19. 46	10. 55	0. 43	12. 0	20. 43	23. 26
25	18. 47	8. 49	2. 5	13. 25	21. 5	23. 24	19. 33	10. 34	1. 6	12. 21	20. 55	23. 24
26	18. 32	8. 27	2. 29	13. 44	21. 15	23. 22	19. 20	10. 13	1. 30	12. 42	21. 6	23. 22
27	18. 16	8. 4	2. 52	14. 3	21. 25	23. 20	19. 6	9. 52	1. 53	13. 2	21. 17	23. 19
28	18. 0	7. 41	3. 16	14. 22	21. 35	23. 17	18. 52	9. 31	2. 16	13. 22	21. 28	23. 16
29	17. 44		3. 39	14. 41	21. 44	23. 14	18. 38	9. 9	2. 40	13. 42	21. 38	23. 13
30	17. 28		4. 2	14. 59	21. 53	23. 10	18. 24	8. 48	3. 3	14. 2	21. 47	23. 9
31	17. 11		4. 26		22. 1		18. 0	8. 26		14. 21		23. 4

A TABLE of the SUN'S DECLINATION,

For the YEARS 1786, 1790, 1794, 1798, 1802, 1806,
1810.

Each being second after Leap-Year.

Days	Jan.	Feb.	Mar.	April	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	South	South	South	North	North	North	North	North	North	South	South	South
1	22.59	16.58	7.24	4.43	15.13	22.8	23.7	17.57	8.9	3.21	14.36	21.54
2	22.53	16.40	7.1	5.6	15.30	22.15	23.2	17.42	7.48	3.44	14.55	22.3
3	22.48	16.23	6.38	5.29	15.48	22.23	22.58	17.26	7.26	4.8	15.14	22.12
4	22.41	16.5	6.15	5.52	16.6	22.30	22.53	17.10	7.3	4.31	15.32	22.20
5	22.34	15.46	5.52	6.15	16.23	22.36	22.47	16.54	6.41	4.54	15.50	22.28
6	22.27	15.28	5.29	6.37	16.40	22.43	22.41	16.38	6.19	5.17	16.8	22.35
7	22.20	15.9	5.5	7.0	16.56	22.49	22.35	16.21	5.56	5.40	16.26	22.42
8	22.11	14.50	4.41	7.22	17.12	22.54	22.28	16.4	5.34	6.3	16.44	22.48
9	22.3	14.31	4.18	7.45	17.28	22.59	22.21	15.47	5.11	6.26	17.1	22.54
10	21.54	14.13	3.55	8.7	17.44	23.4	22.13	15.29	4.48	6.49	17.18	22.59
11	21.44	13.52	3.31	8.29	18.0	23.8	22.5	15.11	4.25	7.11	17.34	23.4
12	21.35	13.32	3.8	8.51	18.15	23.12	21.57	14.53	4.2	7.34	17.51	23.9
13	21.24	13.11	2.44	9.12	18.30	23.15	21.48	14.35	3.39	7.56	18.7	23.13
14	21.14	12.51	2.21	9.34	18.44	23.18	21.39	14.16	3.16	8.19	18.23	23.16
15	21.3	12.30	1.57	9.55	18.58	23.21	21.30	13.58	2.53	8.41	18.38	23.19
16	20.51	12.10	1.33	10.17	19.12	23.23	21.20	13.39	2.30	9.3	18.53	23.22
17	20.39	11.49	1.10	10.38	19.26	23.25	21.10	13.20	2.7	9.25	19.8	23.24
18	20.27	11.27	0.46	10.59	19.30	23.26	21.0	13.0	1.43	9.47	19.22	23.26
19	20.14	11.6	0.22	11.20	19.52	23.27	20.49	12.41	1.20	10.9	19.36	23.27
20	20.1	10.45	1.0 N	11.40	20.4	23.28	20.38	12.23	0.57	10.31	19.49	23.28
21	19.48	10.23	0.25	12.0	20.17	23.29	20.26	12.1	0.33	10.52	20.3	23.28
22	19.34	10.1	0.49	12.21	20.29	23.28	20.14	11.41	0.10	11.13	20.16	23.28
23	19.20	9.39	1.12	12.41	20.40	23.27	20.2	11.20	0.14	11.34	20.28	23.27
24	19.6	9.17	1.36	13.0	20.51	23.26	19.49	11.0	0.37	11.55	20.40	23.26
25	18.51	8.54	2.0	13.20	21.2	23.25	19.36	10.39	1.1	12.16	20.52	23.24
26	18.36	8.32	2.23	13.39	21.13	23.23	19.23	10.18	1.24	12.37	21.4	23.22
27	18.20	8.9	2.47	13.58	21.23	23.20	19.10	9.57	1.47	12.57	21.15	23.20
28	18.4	7.47	3.10	14.17	21.32	23.18	18.56	9.36	2.11	13.17	21.25	23.17
29	17.48		3.33	14.36	21.42	23.14	18.42	9.14	2.34	13.37	21.35	23.33
30	17.32		3.57	14.54	21.51	23.11	18.27	8.53	2.58	13.57	21.45	23.9
31	17.15		4.20		21.59		18.12	8.31		14.16		23.5

A TABLE of the VARIATION of the SUN'S DECLINATION to every 10 Degrees of Longitude.

DEGREES OF LONGITUDE from the MERIDIAN of LONDON.																		
Daily Vari.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Min.																		
2	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
4	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2
5	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2
6	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2	3	3
7	0	0	0	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3
8	0	0	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4
9	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4
10	0	1	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5
11	0	1	1	1	2	2	2	3	3	3	3	4	4	4	5	5	5	5
12	0	1	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6
13	0	1	1	1	2	2	2	3	3	4	4	4	5	5	5	6	6	6
14	0	1	1	2	2	2	3	3	3	4	4	5	5	5	6	6	7	7
15	0	1	1	2	2	3	3	3	4	4	5	5	5	6	6	7	7	7
16	0	1	1	2	2	3	3	4	4	5	5	5	6	6	7	7	8	8
17	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	8
18	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	9	9
19	1	1	2	2	3	3	4	4	5	5	6	6	7	7	7	8	9	9
20	1	1	2	2	3	3	4	4	5	6	6	7	7	8	8	9	9	10
21	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10	10
22	1	1	2	2	3	4	4	5	6	6	7	7	8	9	9	10	10	11
23	1	1	2	3	3	4	4	5	6	6	7	8	8	9	10	10	11	11
24	1	1	2	3	3	4	5	5	6	7	7	8	9	9	10	11	11	12

To find the SUN'S DECLINATION by the foregoing TABLES.

EACH Page of the foregoing Tables contains the Sun's Declination for the Years that it is marked with at the Top, and is divided into thirteen Columns; the first of which to the Left Hand shews the Day of the Month, and the other Twelve the Months of the Year, so that if it be required to find the Sun's Declination for any Day; suppose for Example, on the 21st of August, 1783; First, I look for that Table that has 1779 at the Top of it, and then right against the 21st Day of the Month, and under August, I find 12.7, which shews the Sun's Declination to be 12 Degrees 7 Minutes North; according to the Title at the Top of the Column.

The Sun's Declination in these Tables being calculated for the Meridian of London, if you should be considerably to the Eastward or to the Westward of London, it will cause some Alteration in it; to correct which, the

Table of the Variation of the Sun's Declination is to be used as follows:

First, Look out the Declination for the given Day of the Month, and for the Day following it, and subtract the Lesser from the Greater, the Remainder is the Daily Variation.

Second, Observe whether the Declination be increasing or decreasing, which you may know thus; If the Declination for the Day following the given Day be greatest, then it is increasing, but if it be least, it is decreasing.

Third, Look for the Daily Variation in the first Column of the Table, and see what Number stands right against it, and under the given Degrees of Longitude; which Number is to be used as follows:

If the Difference of Longitude be Easterly, and the Declination increasing, it must be subtracted from the Declination found in the Tables for the given Day; but if the Declination be decreasing, it must be added.

If the Difference of Longitude be Westerly, and the Declination increasing, it must be added; but if the Declination be decreasing, it must be subtracted; the Sum in one Case, and the Remainder in the other, will be the Sun's Declination at Noon in the Longitude required.

Suppose

Suppose on September 10, 1783, a Ship in Longitude 64 Degrees West of London ; what is the Sun's true Declination when on the Ship's Meridian ?

	D. M.	} And because the Declin. is decreasing the Difference must be subtracted ; therefore opposite to 22, and under 60 Degrees of Longitude stands 4 Minutes, which subtracted from 4° 54', gives 4° 50' the Declin. at the Ship.
Decl. at London, Sept. 10, 1783,	4 54 N.	
Ditto at London, Sept. 11,	4 32 N.	
Daily Variation of Declination	22 Miles	

Again, suppose in Longitude 80 Degrees East, on March 20th, 1787, what is the Sun's Declination ? Here the Daily Difference is 24.

	D. M.	} Since the Declination is encreasing, and the Longitude East, it must be subtracted, and the Remainder being nothing, shews that the Sun is upon the Equinoctial at the Ship's Meridian.
Sun's Decl. March 20	0 5 N.	
Variation for 100 Degrees.	5	
Declination at Noon at Ship	0 0	

In like Manner may the Declination be fitted to any Meridian ; but it sometimes happens that the Declination is wanted when the Sun is not upon the Meridian ; in such Cases it is best to find the Declination for the preceding and following Noons, and take the Difference, and then say, as 24 Hours is to that Difference, so is the Hours from Noon to a Fourth Number, which being added or subtracted, according as the Declination is increasing or decreasing, and the Time being in the Fore or Afternoon, gives the Sun's Declination for the given Time.

Suppose it were required to find the Sun's Declination on April 14, 1791, at 8 Hours 55 Minutes in the Morning.

First, I look in the Tables for the Sun's Declination, April 15, 1791, and find it to be 9° 50', and then I look for it April 14, and find it to 9° 28' ; the Daily Difference is 22 Minutes : Then I say as 24 Hours is to 22 Minutes, so is 20 H. 55 M. the Time elapsed since last Noon, to 19 Minutes, which added to 9° 28' because the Declination is increasing, gives 9° 47' for the Declination at the given Time ; but had the Declination been decreasing, the 19 Minutes must have been subtracted.

In like Manner the Declination is found for any Hour of the Day, and under any Meridian, for you have nothing more to do, than to reduce the Difference of Longitude into Time, and add to or subtract it from the given Time, according as the Longitude is East or West, and then find the Declination as above.

The Declinations have been carefully compared with the Nautical Almanac, and computed to the nearest Minute, which is of sufficient Exactness for determining the Latitude by Observation ; but in finding the Time, in order to determine the Longitude, the Declination must be taken out of the Nautical Almanac, it being there calculated to Minutes and Seconds.

A TABLE OF AMPLITUDES.

DECLINATION IN DEGREES.																								
Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
2	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
3	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
4	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
6	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
7	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
8	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
10	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
11	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
12	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
13	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
14	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
15	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
16	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
17	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
18	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
19	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
20	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
21	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
22	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
23	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0
24	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0

A TABLE OF AMPLITUDES.

DECLINATION IN DEGREES.

DECLINATION IN DEGREES.																															
Lat.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Lat.		
34	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	34		
35	1.12	2.25	3.37	4.50	6.2	7.15	8.27	9.39	10.52	12.5	13.18	14.31	15.44	16.57	18.11	19.25	20.39	21.53	23.3	24.21	25.36	26.51	28.7	28.44	29.34	30.23	31.12	32.01	32.90	35	
36	1.13	2.27	3.40	4.53	6.6	7.20	8.33	9.47	11.0	12.14	13.28	14.42	15.55	17.11	18.25	19.40	20.55	22.10	23.25	24.4	25.56	27.13	28.29	29.735	30.63	31.52	32.41	33.30	34.19	35.08	36
37	1.14	2.28	3.43	4.57	6.11	7.25	8.39	9.54	11.9	12.23	13.38	14.53	16.9	17.24	18.39	19.55	21.11	22.27	23.43	25.0	26.18	27.35	28.53	29.30	30.19	31.08	31.97	32.86	33.75	34.64	37
38	1.15	2.30	3.45	5.0	6.15	7.31	8.46	10.2	11.17	12.33	13.49	15.5	16.21	17.38	18.54	20.11	21.28	22.46	24.3	25.21	26.39	27.58	29.17	29.56	30.45	31.34	32.23	33.12	34.01	34.90	38
39	1.16	2.32	3.48	5.5	6.21	7.37	8.54	10.11	11.27	12.44	14.1	15.18	16.35	17.53	19.10	20.28	21.46	23.3	25.24	26.43	27.62	28.81	29.40	30.29	31.18	32.07	32.96	33.85	34.74	35.63	39
40	1.17	2.34	3.51	5.8	6.26	7.43	9.1	10.19	11.37	12.54	14.12	15.31	16.49	18.8	19.27	20.46	22.6	23.26	24.46	26.6	27.27	28.49	29.11	30.23	31.34	32.45	33.56	34.67	35.78	36.89	40
41	1.18	2.36	3.55	5.13	6.32	7.50	9.9	10.28	11.47	13.6	14.25	15.45	17.5	18.24	19.44	21.5	22.26	23.47	25.9	26.31	27.53	28.16	29.38	30.49	31.60	32.71	33.82	34.93	36.04	37.15	41
42	1.19	2.39	3.58	5.18	6.38	7.57	9.17	10.37	11.57	13.18	14.39	15.6	17.21	18.42	20.4	21.26	22.48	24.10	25.33	26.56	28.21	29.46	30.16	31.31	32.46	33.61	34.76	35.91	37.06	38.21	42
43	1.21	2.41	4.2	5.23	6.44	8.5	9.26	10.47	12.9	13.31	14.53	16.15	17.37	19.0	20.23	21.46	23.10	24.34	25.58	27.24	28.50	30.16	31.43	32.26	33.41	34.56	35.71	36.86	38.01	39.16	43
44	1.22	2.44	4.6	5.28	6.51	8.13	9.35	10.58	12.21	13.44	15.5	16.31	17.55	19.19	20.43	22.8	23.34	24.59	26.25	27.53	29.20	30.48	31.23	32.48	33.73	34.98	36.23	37.48	38.73	39.98	44
45	1.23	2.47	4.10	5.34	6.58	8.21	9.45	11.9	12.34	13.58	15.23	16.48	18.13	19.39	21.5	22.32	23.59	25.26	26.54	28.23	29.53	30.27	31.58	32.33	33.58	34.33	35.58	36.33	37.58	38.33	45
46	1.25	2.50	4.15	5.40	7.5	8.30	9.56	11.21	12.47	14.13	15.38	17.6	18.33	19.0	21.28	22.56	24.25	25.54	27.28	28.56	30.27	31.58	32.33	33.58	34.33	35.58	36.33	37.58	38.33	39.58	46
47	1.26	2.53	4.19	5.46	7.12	8.39	10.6	11.34	13.1	14.28	15.56	17.25	18.54	20.23	21.52	23.23	24.53	26.25	27.58	29.31	31.0	32.37	33.12	34.37	35.12	36.37	37.12	38.37	39.12	40.37	47
48	1.28	2.56	4.24	5.52	7.20	8.49	10.18	11.47	13.16	14.44	16.15	17.45	19.16	20.47	22.18	23.50	25.23	26.57	28.32	30.0	31.42	32.23	33.48	34.23	35.48	36.23	37.48	38.23	39.48	40.23	48
49	1.29	2.59	4.29	5.59	7.29	8.59	10.30	12.0	13.31	15.2	16.34	18.6	19.39	21.12	22.45	24.40	25.55	27.31	29.7	30.45	32.23	33.48	34.23	35.48	36.23	37.48	38.23	39.48	40.23	41.48	49
50	1.31	3.3	4.34	6.6	7.38	9.10	10.42	12.14	13.47	15.21	16.54	18.28	20.3	21.38	23.14	24.51	26.28	28.6	30.45	32.23	33.48	34.23	35.48	36.23	37.48	38.23	39.48	40.23	41.48	42.23	50
51	1.33	3.6	4.40	6.14	7.48	9.21	10.55	12.29	14.5	15.40	17.16	18.52	20.29	22.6	23.45	25.24	27.3	28.43	30.25	32.8	33.52	35.37	36.26	37.40	38.20	39.50	40.30	41.50	42.30	43.10	51
52	1.35	3.10	4.46	6.22	7.58	9.33	11.9	12.46	14.24	16.1	17.39	19.18	20.57	22.37	24.18	25.59	27.41	29.24	31.8	32.54	34.41	36.30	38.23	39.19	40.15	41.11	42.07	43.03	44.00	45.00	52
53	1.37	3.15	4.52	6.30	8.8	9.46	11.24	13.3	14.43	16.23	18.6	19.44	21.26	23.8	24.52	26.36	28.21	30.7	31.55	33.44	35.34	37.27	39.24	40.23	41.21	42.19	43.17	44.15	45.13	46.11	53
54	1.40	3.20	4.59	6.39	8.19	10.0	11.40	13.21	15.3	16.46	18.29	20.12	21.57	23.42	25.28	27.16	29.4	30.53	32.45	34.38	36.33	38.29	40.29	41.29	42.29	43.29	44.29	45.29	46.29	47.29	54
55	1.42	3.24	5.5	6.49	8.31	10.15	11.57	13.41	15.26	17.11	18.57	20.43	22.3	24.18	26.7	27.58	29.50	31.42	33.38	35.35	37.32	39.26	41.43	42.40	43.37	44.34	45.31	46.28	47.25	48.22	55
56	1.45	3.29	5.14	6.59	8.44	10.30	12.15	14.2	15.49	17.37	19.26	21.14	23.5	24.56	26.49	28.43	30.39	32.35	34.35	36.36	38.39	40.47	42.56	44.44	45.41	46.38	47.35	48.32	49.29	50.26	56
57	1.47	3.34	5.22	7.10	8.57	10.47	12.35	14.24	16.14	18.5	19.56	21.49	23.43	25.37	27.34	29.31	31.31	33.33	35.36	37.42	39.51	42.4	44.19	45.27	46.24	47.21	48.18	49.15	50.12	51.09	57
58	1.50	3.40	5.31	7.22	9.11	11.4	12.56	14.48	16.45	18.33	20.29	22.25	24.23	26.21	28.20	30.24	32.27	34.34	36.46	38.53	41.9	43.27	45.50	47.25	48.50	49.75	50.50	51.25	52.00	53.00	58
59	1.53	3.46	5.40	7.34	9.26	11.22	13.18	15.14	17.10	19.7	21.4	23.4	25.4	27.4	29.4	31.21	33.28	35.40	37.54	40.12	42.34	44.59	47.30	48.46	49.62	50.78	51.94	53.10	54.26	55.42	59
60	1.56	3.53	5.50	7.47	9.43	11.47	13.41	15.41	17.41	19.41	21.41	23.41	25.41	27.41	29.41	31.41	33.41	35.41	37.41	39.41	41.41	43.41	45.41	47.41	49.41	51.41	53.41	55.41	57.41	59.41	60
61	2.0	4.0	6.0	8.1	10.2	12.4	14.6	16.10	18.14	20.18	22.26	24.34	26.46	28.55	31.9	33.27	35.47	38.9	40.16	43.10	45.48	48.31	51.24	52.51	54.78	56.05	57.32	58.59	60.86	61.13	61
62	2.3	4.8	6.12	8.17	10.21	12.27	14.34	16.40	18.49	20.57	23.10	25.23	27.39	29.56	32.16	34.39	37.5	39.36	42.11	44.52	47.40	50.35	53.42	55.17	57.61	59.05	60.49	61.93	63.37	64.81	62
63	2.7	4.15	6.24	8.32	10.41	12.52	15.5	17.14	19.28	21.42	23.59	26.17	28.37	31.1	33.27	35.57	38.31	41.10	43.54	46.46	49.46	52.56	55.66	58.76	61.86	63.96	65.06	66.16	67.26	68.36	63
64	2.12	4.24	6.37	8.5	11.4	13.19	15.34	17.51	20.9	22.27	24.51	27.15	29.42	32.12	34.45	37.23	40.5	42.54	45.49	48.53	52.7	55.36	58.24	61.12	63.00	64.88	66.76	68.64	70.52	72.40	64
65	2.17	4.33	6.51	9.9	11.28	13.47	16.8	18.30	20.54	23.18	25.48	28.19	30.52	33.30	36.11	38.57	41.49	44.41	47.33	50.25	53.17	56.09	59.01	61.93	64.85	67.77	70.69	73.61	76.53	79.45	65
66	2.22	4.44	7.6	9.30	11.54	14.19	16.45	19.13	21.43	24.13	26.50	29.28	32.9	34.55	37.46	40.42	43.40	46.38	49.36	52.34	55.32	58.30	61.28	64.26	67.24	70.22	73.20	76.18	79.16	82.14	66
67	2.27	4.55	7.23	9.25	12.21	14.53	17.26	20.0	22.37	25.14	27.58	30.44	33.34	36.29	39.24	42.19	45.14	48.09	51.04	54.00	56.95	59.90	62.85	65.80	68.75	71.70	74.65	77.60	80.55	83.50	67

A TABLE shewing the Time of the Sun, Moon, and Star's Setting, when they have North Declination, or the Time of their Rising, when they have South Declination.

A TABLE shewing the Time of the Sun, Moon, and Star's Setting, when they have North Declination, or the Time of their Rising, when they have South Declination.

D E G R E E S O F D E C L I N A T I O N.																											
Lat.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	1320		
10	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM	HM		
10	6.00	6.00	6.0	6.00	6.00	6.00	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02		
11	6.00	6.00	6.0	6.00	6.00	6.00	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.04		
12	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.03	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.05		
13	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.07		
14	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.08		
15	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
16	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
17	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
18	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
19	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
20	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
21	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
22	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
23	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
24	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
25	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
26	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
27	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
28	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
29	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		
30	6.00	6.00	6.0	6.01	6.01	6.01	6.02	6.02	6.02	6.03	6.03	6.03	6.04	6.04	6.05	6.05	6.05	6.06	6.06	6.07	6.07	6.08	6.08	6.09	6.09		

To find the Time of the Sun's Rising, Setting, and Length of the Day and Night, by these Tables.

First. Find the Sun's Declination at the Top of the Page (marked with the Degrees of Declination) and the Latitude in the Right, or Left Hand Columns (marked Lat.) and in the common Angle of Meeting is the Time of Sun setting, if the Sun has North Declination, but the Time of Sun rising, if the Sun has South Declination.

E X A M P L E I.

Let it be required to find the Time of the Sun's Rising and Setting, with the Length of the Day and Night, in Latitude 51° North, the 18th of July, 1784?

I first seek the Sun's Declination for the given Day, and find it $20^{\circ} 55'$ North, which I here call 21° , then under the Declination 21 , and against the Latitude 51° , stands 7 Hours, 53 Minutes, the Time the Sun sets on the given Day, in Lat. 51 North, which being doubled, gives 15 Hours, 46 Minutes, the Length of the Day; and, if 7 Hours, 53 Minutes the Time of Sun-setting be subtracted from 12 Hours, the Remainder 4 Hours, 7 Minutes, gives the Time of the Sun's Rising, which being doubled, gives 8 Hours, 14 Minutes Length of the Night.

But, when the Sun has 21° South Declination in this Latitude, the Time of Sun Setting becomes the Time of Sun Rising, and the Length of the Day will then become the Length of the Night.

Thus, the 25th of November, 1784, the Sun's Declination is $20^{\circ} 57'$ South, or 21° , then the Time of Sun Rising is 7 Hours 53 Minutes, his Setting 4 Hours, 7 Minutes, and the Length of the Night 15 Hours, 46 Minutes, and Day 8 Hours, 14 Minutes.

E X A M P L E II.

Let it be required to find the Time of the Sun's Rising, Setting, and Length of the Day and Night, at Petersburg, the 21st June 1788.

Under $23^{\circ} 28' N.$ the Declination that Day, and against 60° North, the Latitude of Petersburg.

Stands the Sun's Setting

12 0
9 19

The Time of Sun Rising

2 41

Sun Setting doubled is the Leng. of Day 18 38

Sun Rising doubled is the Len. of Night 5 42

E X A M P L E III.

Required the Time of the Sun's Rising and Setting, and Length of the Day at the Cape of Good Hope, in Lat. $34.22 S.$ the 15th of May, 1784.

Under the Declination $19^{\circ} 4'$ or $19^{\circ} N.$ and against the Lat. $34 S.$

Stands the Sun's Rising

12 0
6 53

Time of Sun's Setting

5 7

2

The Length of the Day

10 14

And 6 H. 53 M. doub. is Len. of Night 3 46

When a greater Degree of Accuracy is required, proportional Parts may be taken for Degrees and Minutes of Latitude and Declination.

To find the Rising and Setting of the Stars.

By these Tables the Rising and Setting of any Star may be found, whose Declination does not exceed $23^{\circ} 30'$ North or South in the following Manner.

If you are in North Latitude, and the Star has North Declination, look for the Declination at the Top, and the Latitude in the Right or Left Hand Columns, in the Angle of Meeting, is Half the Time of the Stars continuance above the Horizon, in that Latitude; or the Time it takes in Ascending from the Eastern Side of the Horizon to the Meridian, and Descending from the Meridian to the Western Part of the Horizon.

Therefore, if these Hours and Minutes be subtracted from the Time of the Star's coming to the Meridian, the Remainder will be the Time of the Star's Rising, and if added, the Sum will be the Time of the Star's Setting

E X A M P L E I.

Required when the Star Arcturus Rises and Sets December 1, in Lat. $51^{\circ} N.$

The Time of the Star's coming to the Meridian, or Southing in the Morning

9 34

Then under Star's Declination $20^{\circ} 2'$ or $20^{\circ} N.$ and against Lat. 51 stands

7 47

Time of Star's Rising in the Morning

1 47

17 21

12

Star Sets 21 Minutes after 5 in the Evening

5 11

When the Latitude is North, and the Star has South Declination, or the Latitude South and the Star has North Declination; find the Latitude in the side Columns as before, against which, and under the Degrees of Declination, stands Half the Time the Star is under the Horizon, which being subtracted from 12, the Remainder will be Half the Time the Star will be above the Horizon in that Latitude.

Example. What Time will the Dog Star, Sirius, Rise and Set at London, January 25.

Under the Declination $16^{\circ} 25'$ S. and against Lat. $51^{\circ} 32'$ stands

12 0
7 26

Half the Time the Star is above the Horizon

4 34

The Star comes to the Meridian in the Evening, at

10 00

Which Subtracted, shows that the Star Rises at 26 M. after 5 in the Evening

5 26

Added, shows the Time the Star sets in the Morning

2 34

In like Manner may the Rising and Setting of the Planets be found when their Declination does not exceed $23^{\circ} \frac{1}{2}$, and the Time of their Passage over the Meridian is known.

Suppose it were required to know the Time of Jupiter's Rising and Setting, in Latitude 52° North, the 1st of October 1786?

In the Nautical Almanac for 1786, I find that Jupiter passes over the Meridian of Greenwich at 14 H. 41 M. that is 41 M. after 2, next Morning on the given Day, and his Declination is $16^{\circ} 40' N$.

Now, 12 H. added to 14 H. 41 M. is 26 H. 41 M. from which subtract 24 H. and the Remainder 2 H. 41 M. is the Time of his passing the Meridian on the Morning of that Day according to the civil Account.

Under Declination $16^{\circ} 40'$ or 17° and against Lat. 52° stand 7 H. 32 M. half the Time Jupiter is above the Horizon, this doubled is 15 H. 4 M. the Length of Jupiter's Day, which subtracted from 24 H. gives 8 H. 56 M. the Length of his Night.

Again, 7 H. 32 M. added to his passing the Meridian 2 H. 41 M. gives 10 H. 13 M. his setting in the Morning, and 2 H. 41 Minutes added to 12 H. gives 14 H. 41 Minutes, from this Sum take 7 H. 32 M. and the Remainder 7 H. 9 M. is the Time of his Rising in the Evening.

Suppose it were required to find the Moon's Rising and Setting September the 3d, 1786, in Lat. 52° North?

In the Nautical Almanac, (page 6th) I find that the Moon passes the Meridian of Greenwich at 8 H. 12 M. in the Evening, and her Declination at Midnight is $22^{\circ} 55'$ South.

Then in the Tables, under the Declination $22^{\circ} 55'$ or 23° , and against the Lat. 52° stands 8 H. 12 M. Half the Time she is under the Horizon, doubled is 16 H. 24 M. the Length of the Lunar Night, which subtracted from 24 H. leaves 7 Hours 36 M. the Lunar Day. To the Moon's Southing or Passage over the Meridian, 8 H. 12 M. add half the Lunar Day 3 H. 48 M. gives 12, her setting at Midnight, and from 8 H. 12 M. take 3, 48 the Remainder, 4 H. 24 M. is the Time of her Rising in the Afternoon.

In like Manner may be found the Rising and Setting of the other Planets, only observing, that the Noon of the common Day, and end of the Sea Day, is the beginning of the Day in the Nautical Almanack.

As all the Calculations here are made for the Meridian of London, or Greenwich, therefore Care must be taken to reduce the Time of their Passages over the Meridian of Greenwich, to the Meridian of the Place of Observation, by allowing 1 H. later for every 15° of West Longitude, and 1 H. sooner for every 15° of East Longitude.

It were to be wished, that Gentlemen belonging to the Sea, would carry a celestial Globe with them, upon which all the above may be found in an easy Manner; for they would have nothing more to do but to set the Globe North and South, raise the Pole as many Degrees above the Horizon as the Latitude is; bring the Sun's Place to the Brazen Meridian, and set the Index to the upper 12, then turn the Globe round, and note what Stars come to the Meridian, and the Hour Index will point to the Time; when they come above the Horizon it will point to the Time of their Rising, and when they descend below the Horizon it will point to their Setting, for as each Star on the Globe will point directly to one of the same Name in the Heavens, they may be viewed at any Time of the Night; or, if a Planet, turn the Globe until the Index points to the Time of their Passage over the Meridian, and make a Mark on the Globe with a Pencil under their Declination, then turn the Globe East until the Mark comes to the Horizon, and the Index will point to the Time of their Rising, and turned Westerly till it come to the Horizon, the Index will point to the Time of their Setting.

The following Hints may not be unworthy the Seaman's Notice.

The best Method for preventing Vessels Anchors from coming Home.

IF you are under the Necessity of coming to an Anchor on a Lee-shore, or in any narrow Roadstead where there is deep Water, and you have the least Suspicion of the Ground being too hard or too light for good holding Ground, drop your common Riding Bower, first keeping 25 or 30 Fathom of Cable on board, and if you perceive by dropping the Lead over, or by the Land or any other Means that your Vessel drags her Anchor, drop your best Bower, and at the same Time veer out the Remainder of the common Bower Cable till the best Bower checks her, after which bend a sufficient Rope or Hawser to the common Bower without the Hawse Hole, and pass it through another Hawse Hole to the Wind-lass, making it fast, then cast off the common Bower, and having passed the Cable-End thro' Hawse-Hole, take a running Clinch with it round the best Bower Cable and let it go; when after you think the Vessel has dragged her best Bower Anchor far enough to straiten the common Cable on the Ground, you may veer out as much of the best Bower as you please, and though the Weather should be ever so violent you may be assured she will not drag them home. If your Vessel be small and rides hard in a Head Sea, nothing will assist her more than fastening an empty Butt to the Cable, about ten Fathom from the Vessel, by receiving the Motion of the Sea first, checks the Vessel, and causes her to come up to the Swell, and by that Means avoid half its Force.

Of Fothering Vessels.

Take a Studding-sail, or some other small Sail, mix a Quantity of Oakham and Wool together, chopped small, and stick it in Handfuls down to the Sail as lightly as you can, and overspread such Dung and Filth as you have on Board, but if Horse-Dung the better; the Sail being thus prepared, haul it under the Ship's Bottom by Ropes so fastned to the Sail to keep it extended, the Suction which incites the rapid Entrance of the Water will draw the Composition from the Surface of the Sail, and force it into the Leak in such Quantity, as if not wholly to stop it, at least to keep out so much Water as to render the Danger trifling.

Of Vessels running or driving on Shore.

If your Vessel should be so much embayed as to be obliged to bring upon a Lee-Shore, and you are apprehensive of her parting her Cable, or being otherwise unable to ride the Gale out, keep her to her Anchor, if you possibly can, till the turn of High Water, then before you slip or cut get what Sails you can ready for hoisting at a Moment's Warning. If your Ship falls head to Wind, and you think she will not wear with much Sail, I presume you will use your Fore-sails only, with which Sails you may run till you have just Time to lower them, and hoist your Main Sails, (for if a Ship, and she will bear her Mizen Sails only without broaching too, so much the better) before the Ship strikes; which being done, as soon as you perceive by your Lead that you are near the Ground, caute whatever is easiest to be moved to be placed on that Side of the Vessel which will readiest and safest become the Lee-side; and as soon as you find her near touching, lay her as nearly as you can Broadside too, and heel her in as much as you with Safety can. In the first Place then, with respect to the keeping your Vessel at her Anchor if possible, till the Turn of High Water, by so doing you will lay her on Shore on the young Ebb, and will have the Remainder of the Ebb, and great Part of the next Flood, to preserve the Effects of the Vessel; and should there be any Likelihood of the Gale abating, you will have long Ebb to carry Anchors out, in order to get your Vessel off, to say nothing of her being under Water every Tide, in Case she bulges, the natural Consequence of a Vessel grounding on the latter Part of an Ebb, which is of no small Consideration. In the next Place, by taking in your Head-sails, and hoisting
you

your Main or After-Sails, the Vessel will shoot a-Head much easier by being eased of the Pressure of her Head-sails; and on the same Account, will run into Shoaler Water, and the Main or After-Sails being out, will enliven the After-part of her, and run her up with the greater Facility. By laying your Vessel's Broadside to the Sea, you obtain many Advantages; for instance, should the Sea run high, your own Boats, or those from the Shore, may come to your Lee-Side with the greatest Safety, as the Length of the Vessel will smooth the Water along way in, and by that Means greatly assist in saving the Crew. The Vessel will dry, or nearly dry together, and permit Boats or Carriages to come along-side with Ease, at the same Time that the Vessel heeling in, permits the Goods to be taken out with great Safety and Expedition, and should there be an Opportunity of endeavouring to get her off, by laying Broadside to Sea, her Head may be hove round with Ease, and when a-float, by heaving short her Stern will lighten.

To Link-worm a Cable, to prevent them from being wounded, or parting in rocky or stony Ground, and to defend them from the Ice.

As a Cable, though however well laid, is by no Means capable of enduring the Friction of a rocky or stony Bottom, I would recommend every Master and Commander to have three Chains, each about 15 Fathom long, all of a Size, and proportionably large, so that when wound round the Cable they may project so far without it as to receive the chief Body of Friction; let one End of each Chain be made fast to the Ring of the Anchor, and then worm each Chain slightly round its respective Channel of the Cable, so as not to check it from stretching, fastening the other end of each Chain to the Cable; the Chains need not be made very heavy, and the Links should be short, as they will then worm much easier; these Chains will receive the whole Friction and chafing of the Rocks and Stones, and will completely guard the Cable from being wounded; as they are put on in a very few Minutes there will be no Necessity of having them fitted on, but when there is a Probability of being obliged to bring up in a Situation where they become necessary; and here I cannot help saying that it is too probable many Vessels have been lost for want of a proper Attention being paid to their Cables at the Slack of the Tides, by heaving them short, and veering out as the Tide strengthens. On the contrary, in order to avoid a little Trouble, the Cables have been suffered to kink, when if the Wind has freshened let the Cables have been ever so good, the first foul Sea that struck against them has snapped them, and possibly before they could be brought up to other Anchors, they are driven on Shore, and much damaged, if not totally lost. The Weight of the 3 Chains, if a large Cable, will not exceed 500 Weight, and the only trifling Difficulty which will attend carrying this Method into Practice, will be the Hawse-Holes being perhaps too small; if so, should the scheme be deemed worthy of Notice or Trial, Hawse-Holes may with ease be enlarged, the Cable will pay out with the same Ease as if there were no Chains round it, and if it should come in rather heavier than usual, a Boy, or spare Man, may be placed in the Head of the Vessel, to cast off the Chains as they come up, and hand them in above; there probably may be a few Minutes more Difficulty attending this Plan than the common weighing of an Anchor, but we are to observe that a Grain or two of Trouble ought by no Means to be placed in Competition with the Load of Preservation which may attend the Vessel and Crew by making use of it.

In high Latitudes, where Ice may cut or damage the Cables, while riding at Anchor, it would be best to have 3 other Chains of the same Nature with the former, but only five or six Fathom in length, which by being wormed round the Part of the Cable that is at the Edge of the Water, would prevent the Ice from wounding it or chafing it quite asunder, which has frequently happened during the Winter Season on our own Coasts.

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